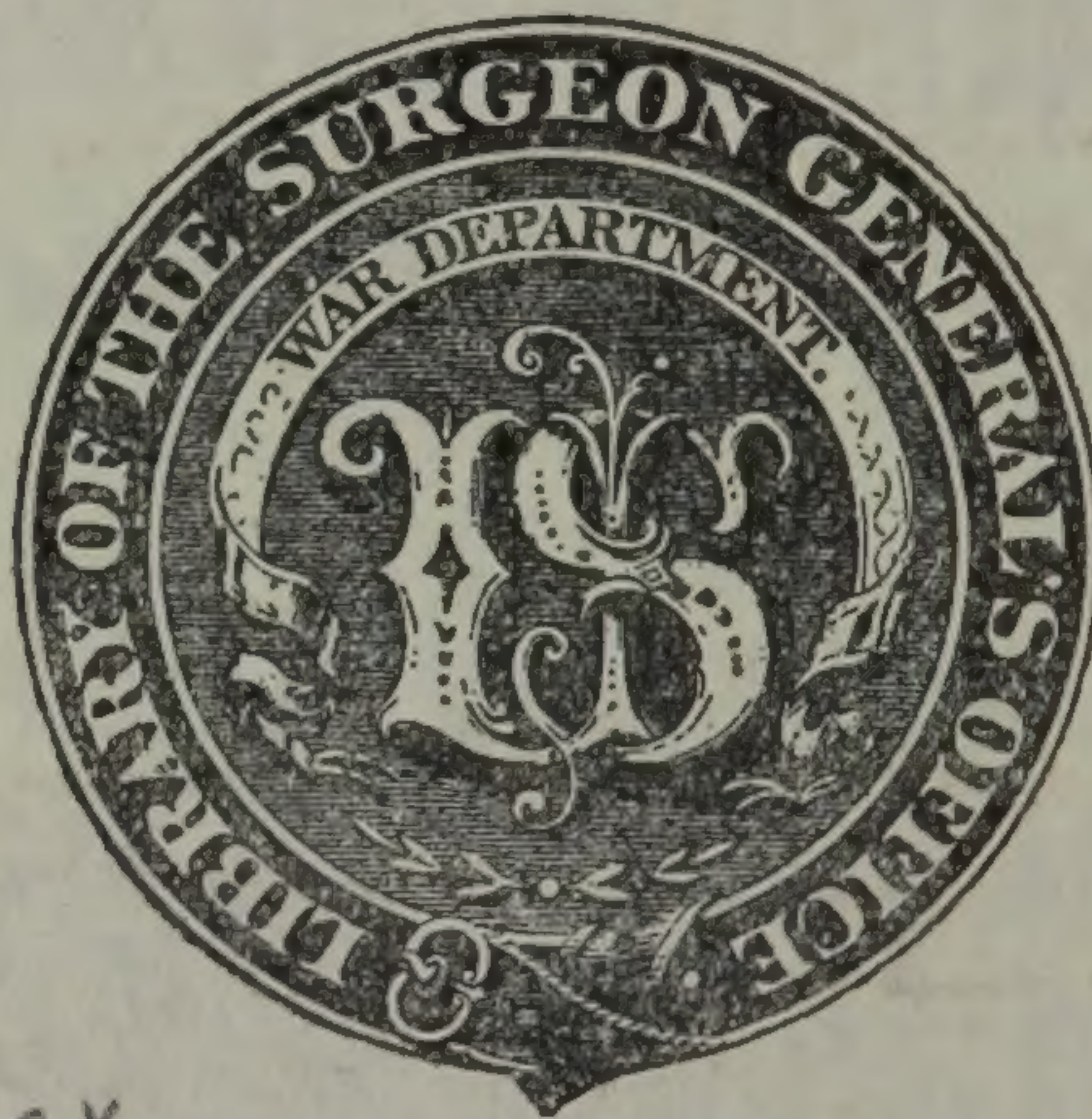






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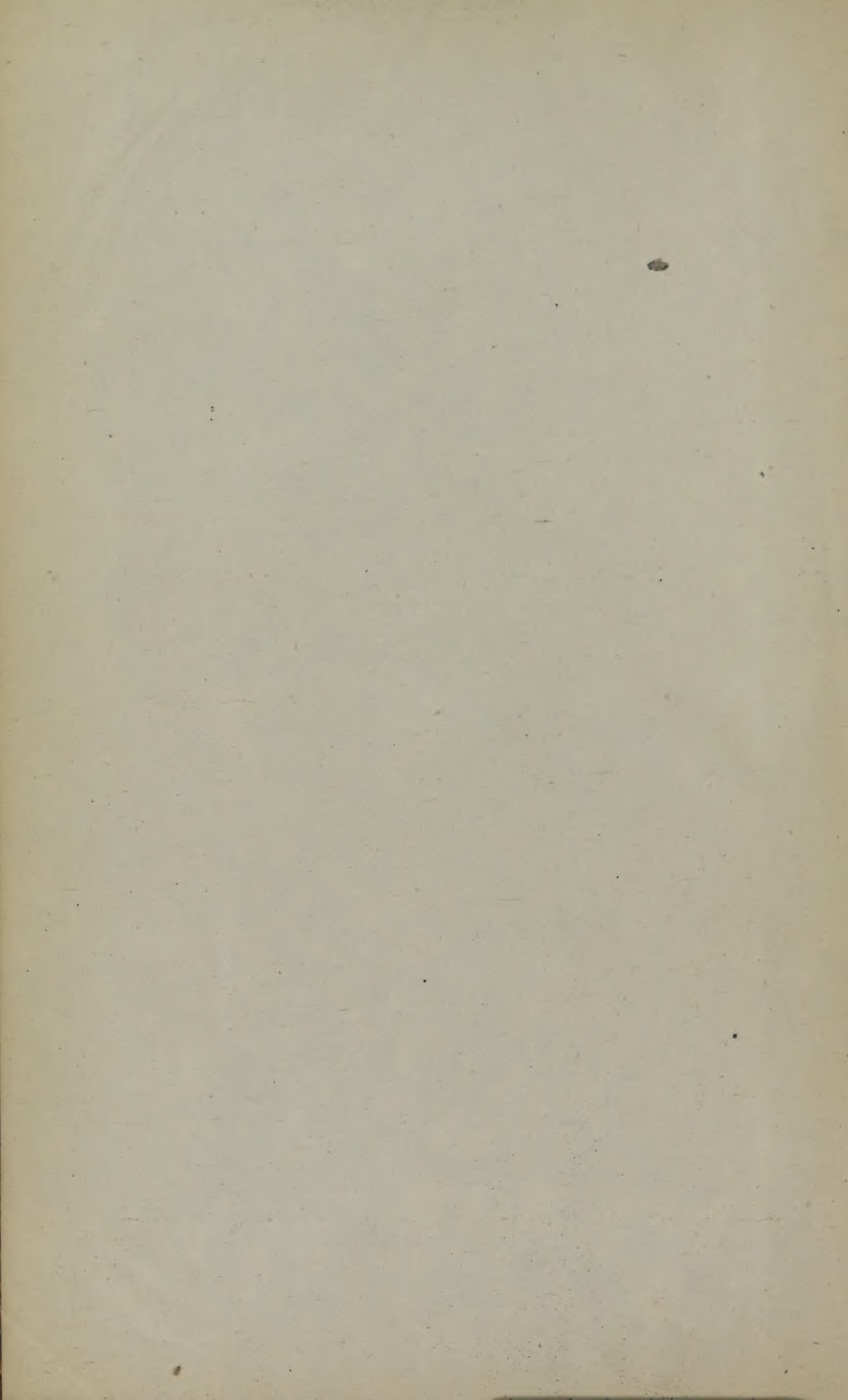


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CHEMICAL ESSAYS

IN REFERENCE TO  
DENTAL SURGERY.

BY  
GEORGE WATT, M.D., D.D.S.,

PROFESSOR OF PATHOLOGY AND THERAPEUTICS, LATE PROFESSOR OF CHEMISTRY AND  
METALLURGY IN THE OHIO COLLEGE OF DENTAL SURGERY, ETC. ETC.

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TO  
MRS. SARAH JANE WATT,  
TO WHOSE SYMPATHY AND CO-OPERATION  
ITS PRODUCTION IS MAINLY DUE,

*This little Volume*  
IS AFFECTIONATELY INSCRIBED BY  
THE AUTHOR.







## PREFACE.

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THE essays contained in this volume were written for publication in the DENTAL REGISTER, without a thought of their appearing in any other form.

Both by private letter and personal interview, the author is very frequently asked for detailed statements of his views on subjects more or less fully discussed in these papers. Having neither the time nor strength to comply with the solicitations thus made, nor to answer the various questions propounded to him, as satisfactorily, to himself or others, as many of them are answered in these essays, he has been induced, in accordance with the advice of many of his best friends, to offer them to the public in this form.

With the hope that they may do something to advance the worthy cause for which we all labor, they are respectfully submitted.







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# CHEMICAL ESSAYS.

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## LORD OXYGEN.

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From an Introductory to a Course of Lectures  
on Chemistry, 1860.

---

MAN is, to a great extent, a creature of habit. He dislikes sudden changes. The schoolboy lingering on the bank, shrinking from the sudden plunge into the cold stream, demonstrates this truth to himself, while the pallid cheek and compressed lips of the commander about to order a charge, demonstrate the same truth to others. A disposition to hesitate precedes all great undertakings; and this is the great cause of that procrastination, known as "the thief of time," which, manifesting itself mainly in reference to repentance and matrimony, peoples this world with old bachelors and the next with reprobates. About to engage in a great undertaking, shall we not be allowed to indulge in the luxuries of this universal law of laziness? About to embark for a four months' voyage, on the deep sea of an abstruse science, with imperfect charts, and inexperienced sailors, is it any wonder we incline to linger in port, and while away an hour, in view of the long toil before us? Let us, then, prove ourselves members of the great human family of procrastinators, by spending this hour, with less of toil and mental labor than will fall to our lot in the hours which are to succeed it.

But man is also a creature of instinct. He can be



taught to know and do many things; but some things he will, and from his very nature, must know and do without any teaching, and even in spite of instruction to the contrary. He eats when he is hungry, drinks when he is thirsty, seeks for warmth when he is cold, and for a cool place when he is hot, not because his reason teaches him to do so, but simply in obedience to the instincts of his nature. Another, and one of his strongest instincts, impels him to worship that which he regards as worshipful. This instinct affords him no guide at all as to what he should worship. To do this, is the province of reason and revelation. And while these infallibly point out the great Creator of all as the only fit object of worship, in the highest sense of the term, yet there is a sense in which "gods many, and lords many," may and should be worshiped (or honored) with true devotion. But even here, reason and revelation must be his guide, or he will sink to the folly and crime of gross idolatry.

All worship, even in this subordinate sense, should be consistent. Consistent idolatry is far less odious than that which is inconsistent. We might pardon the astronomer for his worship of the stars; but we would be disgusted with his homage to a golden calf. Every man should be engaged in a good cause, and should admire, honor, or worship it accordingly.

Being now about to engage in the study of an important science, let us ask ourselves if the cause is not a good one. And if good, shall we not honor ourselves by honoring it? As the youth seeks the society of her whom he adores, so let us manifest our love for this science, by seeking an intimate acquaintance with its truths. •

But if you doubt the propriety of rendering homage to this science, and fear that in doing reverence to it, in all its ramifications, we may be regarded as "too superstitious," let us turn our attention to a single element which



it reveals to us, and inquire to what extent, if at all, it is entitled to our admiration.

What, then, is the character of oxygen? To what extent is it entitled to our consideration? How much respect do we owe it? What reverence must we pay it? Shall we worship it?

Man naturally admires and reverences that which is mysterious. And this element is invisible. It is *seen* only in its works, which are many and wonderful. It forms the ocean and the land. It presides over the atmosphere, and governs the changes which take place on the earth's surface. The other elements are its servants, and are forced to aid in its manifold labors. With one it forms the raindrop and the dew; with another, the balmy atmosphere; with a third, the flinty rock; and with a fourth, the miry clay. With one it fans the genial fire, and with another extinguishes the destroying conflagration. These are but parts of its ways—ever busy, but still invisible.

Nor is this all of its mystery. Where is it? Nay, where is it not? Is it omnipresent? It extends high above the mountain crag, and far below the ocean's bottom. It accompanies, or rather carries, the eagle in his most daring flight, and follows the miner down deep into the bowels of the earth, and is there even before him. It rides on the swift wings of the wind, and rejoices in the storm-cloud; for both are creatures of its construction. It is in the middle of the mountain, in the solid rock, and in all things that live. Man cannot define its boundaries. To him it is, practically, omnipresent.

But think of its power. In the morning of creation it combined with the lightest and least tangible of all its comrades, and formed the fountains, rivers, seas, and oceans. In like manner, by other combinations, it made the solid earth. It seized a bright metal and turned it to lime. It laid hold on the diamond and changed it to a



gas. Forcing these to unite, it formed the solid marble. It raised itself on the wings of the wind and became the vital principle of the atmosphere. And having formed the seas, the dry land, and the air, it presided over and took part in the formation of plants and animals to beautify and people the earth. And ever since it has been busy, and still it is powerful. It organizes the forces of its kindred elements, and works wonders at which man stands aghast. We behold the majestic steamer, stemming the river's current or riding on the angry waves, defying the wrath of the mighty deep, mocking at wind and tide, and reaching in safety its destined port, and all through the agency of this grand and glorious element. The ocean having spread itself out as a barrier to the progress of man, this hero element comes to the rescue. Taking his favorite partner, the delicate Hydrogen, he goes into the very heart of the mighty engine, and together they form its life-blood. He calls for his servant Carbon, and fans him into a flame, imparting warmth, and life, and motion to the mighty machine of his own building; and the ocean is subdued, the winds are overcome, places far distant are brought nigh together, man becomes ubiquitous, and all are neighbors. With the same mighty machine he drags the lightning train across the land, over iron bars of his own forging, laughing at distance and mocking at time. His lightning train over his iron track! Nay, it is thus he travels, at leisure. When pressed for time, he calls down the lightnings of heaven, and sends them forth across land and sea, on the wiry track which he has prepared for their guidance. May we not well exclaim, O Oxygen, great and marvelous are thy works!

But our hero element is powerful to destroy as well as to build up. Few, if any, elements have hardened themselves against him, and have prospered. The strength of iron is as nothing with him, and weapons of steel he



grinds to powder. Gold becomes as fine dust before him, and silver as the blackness of darkness. He calls for the aid of his servant nitrogen, and the solid marble melts like snow. Helped by another servant, the flinty rock becomes grass and stubble before him. The leaves wither at his blighting touch, and nature is dissolved by his blasting energies. Let us think, for a moment, of the ruin he has wrought since creation's morn. The flowers, the trees, the birds and the beasts of ancient days have all been swept away by the hand of this ruthless destroyer. He has swept over the earth, and nations have withered by the blast of his breath. Great Babylon is fallen—is fallen, and by his mighty hand. Where are the cities of the old world? He has burned them to ashes, or crumbled them to dust; and over their ruins he raises the shout of triumph, and rushes forward to new conquests. When the whole world had rebelled, he destroyed it by a flood—all its inhabitants, save one righteous family, which he carried in his bosom, and wafted, by the genial gales of his balmy breath, to a place of safety. He has broken the ships of Tarshish with his east wind. He has overwhelmed fleets and navies in the mighty deep. Great is the ruin he has wrought, and still he is unsatiated. He forges the thunderbolts of war, and gives to them their destructive energy. He manufactures a cooling salt, which, in the hand of two of his servants, becomes a demon of destruction, hurling forth "firebrands, arrows, and death," and imitating the thunders of heaven. Nothing material escapes his destroying hand. He devours the widow's bread, and wastes the fruits of the earth, to create the demon alcohol, that the world may be filled with crime, and men may be changed to devils. He is the merciless executor of that sentence, "Dust thou art, and unto dust shalt thou return."

And then just think of his petty annoyances. While he



blows the smith's fire, he consumes his coals, and wastes his iron. The surgeon rejoices in his shining blade, and the dentist delights in the lustre of his forceps, but he watches for their negligence and covers them with rust. He withers the leaves of the lady's arbor, and sours the milk in the dairymaid's pans. No annoyance is so petty that he will not stoop to it. He addles the egg of the patient bird, and moulds the food of the busy ant. He breathes into the pantry, and the bread becomes stale, the butter rancid, the meal musty, and the meat tainted. He rots the farmer's fruits, his farm-houses and fences, and turns the housewife's jellies and jams to vinegar. In short, he is prying, petulant, and impertinent.

Shall we reverence such an object as this? Shall we even respect it? Nay, shall we not ignore or despise the science that discovers it and reveals its attributes? But why should we not reverence it? Why not even worship it? While sages sacrifice to devils, and savages worship the storm-king, shall we fail to worship oxygen? What if it is the great destroyer of our race? Should we not try to propitiate that which will one day crumble us to dust?

But let us turn from this and think of his goodness. Why, he blesses us every hour—gives us a new blessing with every breath! But how shall we specify his acts of kindness when we owe him our life, and are each moment dependent on him for its continuance? In the earliest moments of our helpless infancy, he breathed into our nostrils the breath of life, and has breathed new life ever since. He allays our hunger, and quenches our thirst, with food and drink adapted to our appetites and desires. He not only surrounds us with good things, but he is so jealous of our welfare that he rushes into and explores every avenue of our bodies, lest there may be something there to harm us. He ransacks our entire systems—veins,



arteries, capillaries, and cavities—and comes out loaded with poison twenty times a minute. He makes every pore of the skin an outlet for the purification of our bodies. He kindles a fire to warm us when we are cold, and fans us with the cooling breeze when we are hot. He builds us houses, like palaces, to dwell in, for our comfort and protection. It would seem as if he were determined that man should live always—not only live, but that he should riot in all the imaginary luxuries of a fabled dream.

Not content that man should live—that he should breathe the balmy air of a life-giving atmosphere, that he should slake his thirst from the sparkling spring, and eat of that which is good, and delight his soul in fatness—our favorite element overwhelms him with delights, of which he could not even dream, were they not constantly showered upon him as happifying realities. How he blesses our sight! He clothes the earth with its carpet of green, and covers the forests with the same gay colors.

“Gay green! thou smiling nature’s universal robe!”

And our hero is the dyer that colors that robe. He paints the flowers with their varied hues, he screens the sunset with its crimson veil, and curtains the heavens with the fleecy cloud. And think of his beauty as he glistens in the dew-drops, and sparkles in the rain, or when he spreads the canvas of the storm-cloud, and illuminates his face with the day-god’s pencilings, in the hues of the bow of promise. He moistens the eye of the maiden till it glistens with love. He fans her cheek till it rivals the rose, and bleaches her brow to the lily’s hue. And even when he appears to frown—when the face of nature is wrapt in decay—he makes her beautiful even in death. When the forest leaves fade—as fade they must, for they are mortal—he beautifies their death-robcs with his varied tints, till the eye is entranced with the gorgeous colors,



and even the south wind accepts them as substitutes, and no longer

“Searches for the flowers  
Whose fragrance late he bore,  
And sighs to find them in the wood  
And by the streams no more.”

But not only does he delight the eye, but he charms us with the melody of nature. He teaches the bee to hum, the bird to warble, and the child to laugh. He gives voice to the singer, and tones to the lute and organ. In short, he blesses us through all our senses.

Nor is he at all capricious in the bestowal of his favors. In spring-time, he moistens the earth with showers, fans it with gentle breezes, and bedecks it with flowers. He makes the grass for the cattle, and the tender herb for the service of man. In summer, he comes riding on the south wind, and warms and fertilizes the earth. He loads the trees with fruit, and causes the grain to grow for the sustenance of man and beast. In autumn, he blesses us with the fruits of the earth, and satisfies us with the increase of the ground. The harvest of the earth is ripened by his breath, and the husbandman rejoices in the abundance of his blessings. In winter, he converts even the fierce north wind into a blessing. He scatters hoar-frost like ashes, or spreads it, in silvery beauty, over the window of the sleeper. He covers the earth with snow, and makes us rejoice in the tinkle of the sleigh-bell. At all times and seasons he is the same kind benefactor.

He disburses his favors not only with a liberal hand, but without partiality. His goodness reaches to all men. Every department of life is blessed by his presence, and aided by his energies. He rewards the labors of the farmer with abundant crops. He brings merchandise from afar, over sea and land, to enrich the trader. He blows the fire for the smith, and turns the mill-wheel and



the spindle. He refines the ores of the metallurgist, and melts the founder's metals. To the physician and the dentist he is indispensable. He prepares the medicines of the one, and purifies the metals used by the other. No department of life is beneath his notice. He toils in the kitchen as a faithful servant, preparing and baking the bread, roasting the meat, browning the coffee, and infusing the tea. He covers our tables with luxuries, and respects the appetites of the most whimsical. He fills the sails of the mariner, and wafts him to his destined port. He floats the schoolboy's tiny boat, and carries aloft his paper kite. He furnishes the painter his colors, and the sculptor his clay and marble. He carries the bird in its rapid flight, and goes deep down into the dark ocean, to bless the great whale and the little fish. He stops at nothing in his errands of mercy. Floods cannot drown him, and fire is but a plaything of his own creation. Height and depth are alike to him, and distance is only his delight. If not revered for his wonderful works, should he not be praised for his goodness?

Here, then, is presented to our consideration an agent, invisible, diffused, mysterious, powerful for good and powerful for evil; that goes about doing good, and, at the same time, seeking what he may destroy; that kills and makes alive; that wounds and heals; whose existence antedates the life of man; which is indestructible as well as unchangeable. However we may estimate it, one thing is certain, that if it had been revealed by our science in ancient days, the great Jupiter would have been deposed to at least secondary rank. Had it been known at Athens, the apostle would not have found an altar "to the unknown God," but to the god Oxygen. And when we reflect on the characters of the gods they worshiped, we are led to pity their ignorance of this wonderful agent, which seems so much more worthy of the homage of their philosophers.



But while we pity, let us inquire if our worship of this would be found more exalted and purifying than their worship of beasts and reptiles, or wood and stone.

What, then, is oxygen? Certainly it is a wonderful thing; for a wonderful God has created it. And because it is a creature, and not a creator, it stands on a level with its kindred elements—on a level with birds, and beasts, and reptiles, and is no more wonderful than they. In the light of our science, everything that God has made is wonderful, and, to us, incomprehensible. Everything is worthy of our admiration; and it is highly proper that the science we are about to study, which has a more extensive range, and reveals more of the mysteries of the material universe than any other you are called upon to investigate, should teach us to “look through nature up to nature’s God;” to see the Creator in all his works; to look upon all the elements as but so many passive instruments in his hand. Till we are able to do this, we have failed to learn the great lesson taught by our science.

But, gentlemen, do you expect to master the science of chemistry in the few short months we are to spend together? As well might the traveler expect to traverse the entire globe in a single day, and return at nightfall to sleep in his cottage. No man on earth will ever get through with the study of this science. But shall we despair on this account? May it not be

“That one of the joys of our heaven shall be”

a fuller and clearer knowledge of the chemical properties of God’s universe than it is possible for us to have here? But you may expect to obtain, by attention and study, such knowledge of it as will make all future study of it a pleasure, and a source of satisfaction.

Are you discouraged and ready to turn back, on finding



that you make so little progress in this science? You have the same cause for discouragement elsewhere; for you have not and never will have a perfect knowledge of any science; nor would you be happy if you had. Here we know only in part; but there—we shall know, even as we are known.



## LADY HYDROGEN.

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An Introductory to a Course of Lectures on  
Chemistry in the Ohio College of Dental  
Surgery, 1866.

---

“WHICH of you, intending to build a tower, sitteth not down first, and counteth the cost?”

About attempting to build the superstructure of professional character on the foundation of professional attainments, may we not spend this hour in counting the cost? A high tower we propose to build; and great in proportion will be the cost. And he who is not willing to incur the necessary expense, had best not attempt the superstructure; for only failure will result, “and all that behold it will begin to mock him, saying, this man began to build, and was not able to finish.”

In view of the magnitude of the science to which I am expected to introduce you; in view of the great depths of ignorance into which we are all fallen; in view of the great heights to which we must climb to gain even a Pisgah view of the promised land of science; in view of the fact that my efforts to guide you will be far too much like the blind leading the blind; in view of the days and nights of mental toil and study in the months before us, it would be but human nature to spend this, the first hour of our acquaintance, in relaxation, if not in absolute rest. But shall we so spend it? Shall we not rather, with the aim of moving “immediately on the works,” devote it to a review of our forces, and an inspection of the work that is before us?



But the scope of that science to which we are assigned is too vast for immediate consideration—too expansive for the survey of a single hour. It extends down to the foundations of the earth, and reaches up to heaven. It includes all of earth, and air, and water, and meteors, and planets, and satellites, and comets, and stars, and suns. All material substances are subject to its laws; and the study of them is but the study of it.

Shall we, then, abandon the building of the intended tower? Having put our hands to the plow, shall we look back? As soldiers marching against the battlements of ignorance, shall we desert our colors? No! but let us inure ourselves to the war by a gentle skirmish, before the grand battle begins. Let us spend this hour in the way of introducing ourselves to each other, and to our work. Like children “playing school,” let us merely “make believe” that this is a lecture and you are students.

Then, of all the material universe, let us select, for present consideration, just one element. And, that our labor may not appear heavy, let us take that one which is the lightest and least tangible,—the pliant, volatile, invisible, combustible little hydrogen.

Hydrogen! what inquiries crowd upon us with the very name! What is it? Where is it found? What is it like? What is it good for? And a score of others. Patience, my friends. Let us consider.

Far away back in the long-ago, before “the morning-stars sang together,” “or ever were formed the earth and the world,” in the distant past, when “He spake and it was done,” God said, “Let there be” and “there was” an element, which from the regal character bestowed on it by its Creator, not inaptly has been called “Lord Oxygen.” And because it was not good for this lordly element to be alone, his Creator saw fit to provide “a helpmeet for him,” and the beautiful hydrogen sprang up by



his side, and their marriage was sealed by the lightning's flash, and announced by the thunder's roar; and, accordingly, we are told, in the family record of creation, that "darkness was upon the face of the *deep*, and the Spirit of God moved upon the face of the *waters*." Ye who worship at the shrine of antiquity, and bow in reverence to "first families," here is something worthy of your devotions. Here is the first recorded instance of definite chemical combination—the first marriage of elements. And so true have they been to each other, so close the tie of affection, so perfect the union, that for thousands of years they were regarded by the whole human race as "no more twain, but one" element.

What, then, is hydrogen? It is the lightest and most ethereal of all known substances. Too light to float the gossamer, or sustain the play of the zephyr's wing, too rare for the breath of the tiny insect, too diffused to carry the rose's perfume—a wonderful something which you can neither see, hear, feel, taste, or smell.

But where is it? Or, a simpler question, where is it not? It is above us, beneath us, around us, in us, of us. Go ask the forests the secrets of their growth, and they will tell you they have been watered and nurtured by the good Lady Hydrogen. Ask the flowers the source of their fragrance, and they will report it as a goodly present from the bride of Lord Oxygen. Admire their brilliant hues, and they will refer them to the artist hand of the same benefactress. Gaze at the rainbow, and you see but her pencilings. See her as she sparkles in the dew-drop, glitters in the rain, or glistens in the icicle. Admire her gentleness and purity, as she descends in the snowflake. Behold her majesty and grandeur, when the ocean is lashed to madness by the fury of the storm. Look at her stateliness in the floating iceberg, at her beauty in the shining frost crystal, at her tenderness in the falling tear.



Explore the wildest, deepest, most remote recesses of nature, and you will find her in advance of you, beautifying, building up, and sustaining. Everything that lives is sustained by her, and, deprived of her genial presence, would pine and die. And though practically almost omnipresent, yet she is never impertinent—never intrudes—neither meddles nor gossips. By her quiet presence, she manifests her willingness to serve those who need her sympathies. Though true to her first love, and faithful to her marriage vows, yet she willingly co-operates with the humblest member of the family of elements, if so she can be useful. Indeed, so modest and retiring is she, that her presence is not suspected, even by those she blesses. “Many daughters have done virtuously,” but she excels them all.

Such brilliance, and gentleness, and purity, and grandeur, and tenderness, and beauty, may well claim our attention and admiration for this hour. Shall we grow sentimental over the historic beauty of Helen, or ecstatic before the image of Venus, and not be filled with rapture in the presence of her who is unrivaled in beauty, and as pure as the angels, the beautiful bride of Lord Oxygen?

Would that I could but show you her portrait, but she shrinks from display. Like the timid maiden of the East, she refuses to unveil. Like the modest wife, she is content that “her husband is known in the gates, when he sitteth among the” elements. She is like the silent benefactor—“she stretcheth out her hands to the poor, yea, she reacheth forth her hands to the needy.” She is like purity itself. The touch of filth does not defile her; nor can the breath of slander defame her. And though her beauty and loveliness may sometimes prove her misfortune, and those chemical bandits, Sulphur, Chlorine, and Phosphorus, may kidnap and carry her off, they find



a constancy they cannot overcome, charms not for them; and, instead of the pleasures they expected to enjoy in her constrained presence, all is acrid and sour; and when her lordly husband comes to her rescue, and consumes these robbers with the breath of his mouth, spotless and undefiled, his own well-beloved flies to his embrace, and “the heart of her husband doth safely trust in her.”

But the gentleness, brilliance, stateliness, grandeur, and beauty of this wonderful lady element are all as nothing when compared with her goodness. While others bestow favors for applause, she blesses for the sake of blessing. So gentle, airy, and light, we would expect her to play with the gossamer, or romp with the butterfly, or to soar away up above the clouds, and sport in the blue ether, among the stars and comets. But had she the strength of iron, the gravity of lead, and the caustic energy of chlorine combined, she could not undertake or accomplish more than she does. Her power is wonderful, and, like the true lady, she rules only by love; and so gentle is her sway, that her subjects are her willing slaves, and are all unconscious of their servitude. And even her lordly husband, with all his energies and passions, is overcome by her affection, and in her embraces he is as gentle as a lamb. Alone, the leaves of the forest wither in the blast of his breath, and nature is defaced by his blighting touch. Soothed by her smiles, he waters the earth, and covers it with its carpet of grass, while the forest is clothed with leaves and flowers, and all nature puts on her holiday garb. Alone, he burns cities to ashes, or crumbles them to dust. Captivated by her gentle sway, he toils like a slave to extinguish the conflagration. Alone, he breaks our ships with his east wind. With her influence and aid, he bears them up, and floats them to the desired havens. Alone, he forges the thunderbolts of war, and hurls them forth on their errands of death. With her, he quenches the



thirst of the wounded and dying, and cools the parched lips and fevered brows of the hospital's inmates. Alone, he devours the widow's bread, and destroys the fruits of the ground to create the demon-drink that fills the world with crime, and changes men to devils. Blest with her genial presence, he furnishes the clear, cool water, which entails only blessings on those who drink it. In many of his grandest and best achievements, he would be utterly powerless, without her presence and her aid. Let us think of this.

"In the day that God created" these wonderful elements, positive and negative "created He them, and blessed them and called their name WATER, in the day when they were created" Life-sustaining, health-giving water! The drink that a God of love has distilled for all his children! The liquor that strengthens, refreshes, revives, invigorates, and purifies. The beverage which has no orphan's tear as its sequel, nor widow's wail as a requiem over its fallen victim. A drink that demons do not delight in. The murderer does not imbibe it to prepare him for his crime, nor the reveler as a prelude to his midnight debauch. No ghosts of murdered innocents awake from their slumbers to curse the cup that contains it, or the fountain that gushes it forth. Dethroned reason does not curse and babble under its influence; nor does delirium travel in its wake. The lone prisoner does not accuse it of the crime that has brought him to the dungeon-cell; nor does the felon on the scaffold curse "the moss-covered bucket" for his untimely end. Prisons and almshouses do not overflow with its victims; nor are courts of justice kept busy with its crimes.

No! our Lady Hydrogen and her liege lord are, in combined labors of love, far otherwise engaged. Like their divine Creator, they go about doing good. They are his agents in preparing rain and making grass to grow



upon the mountains. By them he visits the earth and waters it, and enriches it with the river of God. They are the messengers by which he sends the mollifying shower and the refreshing dew. Out of them is formed the storm-cloud and the rivers, and the seas and the ocean. Nor are they easily baffled in their benign efforts. They impart power to the majestic steamer, and it stems the river's current, and rides the angry billows. Nor is any work too servile for them, if only it be useful. They turn the mill-wheel and the spindle, and draw the produce of the farmer to the distant market, and return laden with the wares of merchandise. They float the mariner's stately ship and the red man's bark canoe. They wash the poisonous malaria from the atmosphere and the filth from the surface of the earth, to impart health and prolong life. They never weary in well-doing, but sustain and bless everything that lives, and without their presence life is impossible.

And with all their usefulness, they do not forget to be ornamental, nor, while supplying necessities, do they ignore luxuries. They humor all our tastes, and gratify all our senses. They cool the fevered brow, moisten the parched lips, and quench our burning thirst. And how they charm our sight! By the north wind's aid, they show us the hoar-frost, the ice-crystal, and the snowflake. By the help of the vernal breezes, they paint the flowers, bedeck the forest, and cover the earth with its carpet of green. They hold up the storm-cloud as a background to the rainbow of promise. They furnish "a way for the lightning of thunder," and thus display to us its grandeur. They hang up, as a curtain, the fleecy cloud, and adorn the sunset with its crimson veil. They take up and bear to us the fragrance of the flowers, as sweet as the perfumes of Araby the blest. And who has not listened with rapture to their music!



“What a joy to press the pillow  
Of a cottage chamber bed,  
And to listen to the patter  
Of the soft rain overhead!”

Who has heard, elsewhere, such music

“As that melody of nature—  
That subdued, subduing strain,  
Which is played upon the shingles  
By the patter of the rain!”

And the purling brook, and the warbling rill—whose  
childhood has not been delighted with their melodies?  
And the merry cascade

“ \* \* \* as it gushes,  
Like a flow of laughter, out—”

who has not felt the power, but who can describe the  
sweetness of its strain?

Thus does our Lady Hydrogen, like a true and faithful  
wife, co-operate with her lordly husband. His glory is  
hers, and her proudest thought is of her relationship to  
him. He is king among the elements, she his early-loved  
and acknowledged queen.

But, though her delight is to assist and co-operate with  
him, yet when duty calls him from her side, she is neither  
despondent nor idle. If he kindles a fire for our comfort,  
she contributes to the fuel. Just think of her going down  
into the dark caverns of the earth ages ago, and there  
embracing her dark-eyed brother Carbon, that she might  
bring him up, at the proper time, to furnish us the heat  
and light whose comfort and cheer enable us to spend this  
hour together, and, thus thinking, you can appreciate a  
little of her self-denial. And, though not able to rule the  
other elements, like her royal husband, yet she often ac-  
complishes as much by management as he does by force.



Is that refractory element, gold, to be subdued? She coaxes the bandit Chlorine into her service, guides him to the culprit, and, during the contest that ensues, returns to the side of her lord. Does chlorine refuse to surrender the captive to the demand of lawful authority? She forms an alliance with Sulphur, another of the banditti, who, overcoming his late comrade, carries off the prisoner, but abandons him to freedom, through fright at the heated anger of Lord Oxygen. Is the benighted and bewildered traveler to be warned against fatal bogs and morasses which lie in his pathway? She plunges into the mire in search of her fiery brother Phosphorus, and, with loving embrace, lures him to the surface, and, in the light of a beacon flash, rejoins her lord.

But what shall I say more? The time would fail me to tell of her marvelous works and her beneficent deeds. She is a wonderful work of a more wonderful Creator. If this is but a passing glance at one of the elements he has made, how extensive the study of them all! If this is the lightest and rarest of all, yet possessed of properties wider than the range of our thoughts, and beyond the reach of our comprehension, how vast the field of science which includes the properties of all of them!

Are you, then, discouraged at the prospect? Do your hearts fail you? Take courage, my friends! The voyage of the world is a long one—possibly too long for your strength and means—but is that any reason you should not enjoy a pleasure-walk? There are foreign countries you would like to see. Deprived of visiting them, must you fail to call on your friends in the next village? The greatest charm of the science we propose to study is its almost infinite extent. It will last us for life; and I hope it will last us for eternity, and that we will all study it in the same class. But, while it is not possible for you to get through with the study of chemistry in your college



course which now commences, it is quite practicable for you to acquire such a knowledge of its principles as will make all future study of it a pleasure rather than a toil, and such as will enable you to apply many of these principles to the wants of the profession to which you aspire.

In the months that we are to be together, it will not only be my official duty, but also my special pleasure, to aid you in the study of this science. It is regarded as a dry subject, but you will not find it so, if you endeavor to understand it. In the name of the faculty, I welcome you to our halls.



## DENTAL CHEMISTRY.

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From an Introductory Lecture, 1855.

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WHEN material substances are properly studied, they teach lessons of great interest and of the highest importance. Man, corporeally considered, is composed of, and surrounded by, matter. It constitutes the whole visible creation, forming a vast field of observation for finite minds. The universe and its Creator may be resolved into two grand divisions, matter and spirit; and two volumes, that of creation and that of revelation, are given us to teach that which we should know concerning them. Each volume teaches much of both divisions. While “the heavens declare the glory of God, and the firmament showeth his handiwork,” we are also taught that “the worlds were framed by the word of God, so that things which are seen were not made of things which do appear.”

But, as intimated in the outset, we now propose to confine our thoughts to the study of matter; and should our minds, as we proceed, be led “through nature up to nature’s God,” it will only evidence that we are properly pursuing and profiting by our lesson.

Matter possesses both physical and chemical properties; and hence we have two corresponding sciences, Natural Philosophy and Chemistry.

The physical properties of matter are commonly divided into general and secondary. The general are common to all bodies; the secondary exist only in some. Extension, impenetrability, mobility, indestructibility, extreme divisi-



bility, gravitation, and porosity are general properties; while softness, hardness, opacity, transparency, color, solidity, fluidity, elasticity, density, etc. are secondary.

The mechanical philosopher resolves, by virtue of these properties, to make matter act upon matter, for his own accommodation and for the benefit of his race. The hard is made to act upon the soft, the elastic upon the solid, and so on, through the whole list, till the result is the thousands of mechanical appliances which distinguish the enlightened from the savage races. The majestic steamer and the cambric needle, the railway train and the child's rattle, are alike the result of a knowledge of these principles practically applied.

The farmer, in view of the divisibility and porosity of matter, pulverizes the earth's surface, that the air and water may be freely admitted to germinate and fructify the implanted seed; and he is rewarded with pastures covered with flocks, and valleys clothed with corn.

The astronomer, using the transparency of some and the opacity of other bodies, constructs an instrument with which he surveys the heavens, travels up the milky-way, above the clouds and beyond the sky, wanders from planet to planet, from star to star, and beholds matter, rolled up in worlds, by the plastic hand of Deity, and hurled on its revolving career.

A different view is that of the chemist. He, too, studies the properties of matter; but, strictly speaking, he is not concerned with its physical properties. It is his province not to examine what bodies are, but of what they are composed. It is his privilege to discover and define the laws by which the Creator controls matter, as body is united with body, forming substances entirely new, as it were, by a sub-creation.

Let us, then, for a moment glance at the chemist's field of labor.



For want of a better mode of expression, we speak of matter being subject to various kinds of attraction; as the attraction of cohesion, which tends to reduce all substances to, and retain them in the solid state; the attraction of gravitation, or that principle which causes bodies suspended in the air to fall to the earth; and chemical attraction or affinity.

Like cohesion, affinity acts only at insensible distances; that is, substances are brought under the sphere of its influence only by apparent contact. It differs, in this respect, entirely from gravitation, which acts at all distances. It differs from cohesion, by its being exerted only between dissimilar particles, while cohesion unites similar particles. For illustration, a block of marble is composed of a vast number of particles, held together by cohesion; and each particle is as really marble as the block itself. But marble is composed of lime and carbonic acid, and these substances are altogether dissimilar, and totally different from marble. They are called the component or constituent parts of marble; and they are united and held together by affinity. The integral particles of a body are held together by cohesion, the constituent parts are united by affinity.

Every chemical phenomenon is produced by the operation of affinity; and hence the chemical properties of bodies are dependent on its action. Its influence extends over all substances, yet it is subject to various modifications. Two substances sometimes manifest no affinity for each other; but a third substance may be added, which has an affinity for both; and a union of all three may be the result. For example, water and oil may be commingled, yet they do not unite; but if an alkali be added, a union of the three ensues, and the formation of soap is the result.

A substance often manifests unequal affinities for two



other substances, and it will then quit the one for the sake of the other. A familiar example of this is afforded by alcohol, camphor, and water. The first has an affinity for each of the others; but you all know that when water is added to tincture of camphor, the gum is precipitated, and floats on the surface.

The union of two substances, by affinity, is called combination; and the result is a new substance, endowed with properties peculiar to itself. When this change is accompanied by the destruction of a previously existing compound, *decomposition* is effected. A vast field is here laid open for experiment. It may be ascertained what substances will combine with each other, and in what proportions they unite, and then the properties of the new substances and their affinities must be examined and ascertained. Other substances must next be examined, to ascertain whether they are simple or compound bodies, and if compound, what are their component elements, and by what process they may be decomposed; and finally, after collecting and arranging an extended series of isolated facts, general principles may be deduced from them, and the result is *the science of chemistry*.

As the object of the chemist is to examine the relations which affinity establishes between bodies—to ascertain the nature and constitution of the compounds it produces, and to determine the laws by which its action is regulated, it follows that *chemistry is the science of affinity*.

This science not only embraces an extensive field, but admits of a very extended application. It justly ranks as a foundation to other sciences. The farmer, after exhausting his strength and skill, is often pained to find his fields unproductive and his crops light. He applies manure, which imparts vigor to the weeds, but none to the crops; he varies the treatment, and an abundant yield of straw, with but little grain, is the result; he changes again, and



his crop has not strength to mature ; again he tries, and may succeed, after losing successive crops and years of toil, while this science would at once have told him the defects of his soil, and the remedies to apply.

The physician may administer a complex prescription, and, to his surprise, witness no results, or results totally different from those expected. An accurate chemical knowledge would allay his surprise, by teaching him that he had commingled incompatible substances. But I need not insist here ; for this science is conceded to be an essential part of a medical education. Indeed, it seems to underlie all correct medical attainments. The botanist may classify and ascertain the general properties of plants, and may partially discover their more obvious medicinal virtues ; but only the chemist can tell in what element, or compound radical, these virtues exist. He only can eliminate these hidden principles, the discovery of which has done so much to bless mankind. Only the chemist can travel through both the organic and inorganic kingdoms of nature, selecting the good and rejecting the baneful. 'Tis his province to create, as it were, new bodies, by the union of those already formed ; to produce the cooling and healthful salt, from the combination of caustic poisons. 'Tis his privilege to discover and apply the antidote to the poisonous dose, whether administered by mistake, or by the hands of villainy. To him society looks for light, when dark suspicion overshadows the death of one of its members ; and, by his analysis, the vilest murderer, too much of a coward even to stab in the dark, is often detected and brought to justice.

The anatomist studies the animal structure, admires the harmonious arrangements of the various organs, grows eloquent over the beautiful adaptation of each to its intended use, calls one structure bone, another muscle, etc. ; and at last, in endeavoring to penetrate still deeper into



the subject, applies to chemistry, to ascertain what substances compose these various tissues; nor does he apply in vain.

The physiologist, with laudable industry, endeavors to find out the uses of the various organs; he investigates the laws of life and observes the origin, development, and growth of the animal tissues; and after tracing the whole back to cell formations, his science will carry him no farther. It is then that chemistry is called in to trace these cells, the starting-point of the organic kingdom, back to their original elements in the inorganic. Through his entire course, from the primary cell to the perfect animal of the highest scale, chemistry is the guide and assistant of the physiologist. And when his journey is completed, when he has, one by one, examined each secretion, she returns, and lights the pathologist through the mazes and intricacies of diseased life; ever and anon stopping to enable him to scrutinize each point of interest by the way. She tells him its condition at her late visit with his predecessor, and unfolds its present state, leaving him only, as it were, to compare results and draw conclusions.

I need not mention the influence of chemistry on the arts. You need not be told that it selects the materials for, and prepares the tools of the mechanic; that it prepares and mixes the colors for the painter; that it furnishes the materials and defines the proportions of the builder's cement; for these are plain to the most superficial observer. It is much to all of the arts—it is all to some of them.

But the question arises in your minds, "Is it anything to Dental Science?"

Let us then, for a short time, consider its relation to and its influence on the science of our own profession. And here you will allow me to premise, in the language



of another of your professors, that "it has done more to develop and advance dental science than any other agency." Before its dawn, the nature, and of course the treatment, of the principal diseases of the dental organs were veiled in darkness and mystery. Even dental caries was supposed, by men of undoubted ability, to be produced, as that in other bones, by internal inflammation. This science teaches us that it always results from external chemical action; it detects the causes, demonstrates their action, defines their origin, suggests the remedies, and prepares them to our hand. And in the selection of materials to fill the cavities of decay, and restore the contour of the tooth, it manifests no sordid meanness; but directs us to that noble and indestructible metal, gold, discarding the whole category of alloys, amalgams, mineral pastes, etc., which none but the unprincipled, and those ignorant of the fundamental truths of this science, ever think of using.

This science teaches the dental surgeon the precise condition of the various secretions with which he is concerned, their deleterious influence when abnormal, and points out and prepares the appropriate remedial measures.

The same science selects the most suitable and only fit materials for artificial bases—prepares them for the mechanical dentist, and instructs him how to use them. It rejects the dead human, animal, and ivory teeth; and from the bowels of the earth brings up the flinty rocks, and the metallic oxyds, and from their combinations manufactures the pearly gem, surpassed only by the Creator's gift, the living teeth.

But it is needless to specify. A correct knowledge of chemistry will guide you safely in the paths of dental truth; while those who neglect her teachings, or spurn her advice, are left to grope their way through bogs of ignorance, prejudice, and error.



Dental Surgery has taken her stand, and is entitled to rank as an honorable profession; hence, her votaries should be honorable men, and, of course, an honor to their profession. To accomplish this, they must be acquainted with the science of their profession; and this alone should be argument sufficient to induce a careful attention to chemistry. I do not mean that you must understand the whole of chemistry; for that is impossible in our present condition. A young man of respectable talent may commence the study in his youth, and pursue it through life, yet fail to overtake it in its onward march. But does this afford a reason for neglecting it? Far from it. What would you think of the geographer who would abandon his science because he could not visit every city and district, climb each mountain, and trace each river? That science is advanced by adventurers in different fields, each pushing to the utmost in his favorite direction. But to pursue his subject successfully, each traveler must understand the first principles of geography.

So it is with chemistry. One applies it to agriculture; another to the mechanic arts and manufactures; another to mineralogy; another to the animal system, and so on. And, as in the former case, each must understand the elementary principles of the science, or totally fail in his effort.

While going over the laws of combination, the doctrine of affinity, nomenclature, etc., the student sometimes inquires, "What has this to do with *Dental* Chemistry?" The commercial student might with equal propriety make a similar inquiry in regard to the primary rules of arithmetic, by asking, "What has this to do with accounts?"

It will be my endeavor, then, to assist you in obtaining, as rapidly as possible, a correct knowledge of elementary chemistry, and in applying it to your professional wants.



If I can aid you in laying a good foundation for future attainments, I shall be satisfied. I trust that I may rely on your attention and co-operation. No one can be more thoroughly aware of the difficulties that lie in our way, or more conscious of incapacity, than myself; yet, relying on your zeal and industry, I expect to succeed.



## THOUGHTS ON DENTAL CARIES.

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DENTAL caries, as ordinarily used, is a misnomer; yet it is more convenient to retain than to abandon its use. A man who has all his life called himself Smith, will find it inconvenient to do otherwise, even when he has discovered that his real name is Thompson. The term dental caries was in general use to designate several distinct morbid conditions of the teeth, before we had any accurate knowledge of their nature. And as the principal phenomena of these conditions are well known, and are easily observed, there is little likelihood of mistakes occurring in regard to the application of the term. The term caries is usually applied to mortification, or rather to ulceration of bone; and it was applied to decay of the teeth, under the supposition that it results from inflammatory action. For want of a better term, we still continue it, finding it easier to modify the definition than to change the word.

It is now admitted, by all who are familiar with the subject, that, whatever may be the predisposing causes, the immediate cause of dental caries is chemical action. It is well known that constitutional causes have much to do with this disease, both in producing badly organized, defective teeth, and in eliminating or preparing the agents which act chemically on them. But no constitution produces teeth so defective that they undergo spontaneous decomposition while retaining a vital connection with the general system. I am aware that a few pathologists still maintain that inflammation of the bony texture of the



teeth is liable to the same terminations as inflammation of ordinary bony tissue; but it is not profitable to debate this point in the present paper. Suffice it to say that the structure and position of the enamel indicate that the danger is from without, not from within.

As soon as it is admitted that decay of the teeth results from chemical action, it is natural to inquire what agent or agents produce this action. Accordingly, we find the profession turned at once in this direction. And when the composition of the teeth is taken into the account, we would infer that the deleterious agents are to be looked for among the acids. And here we have had great confusion of ideas, and are likely still to have it. For example, we are told "that it is proven that nearly all the acids, both mineral and vegetable, act readily upon the teeth." (*Harris' Dictionary*, article "Caries of the Teeth.") Upon any part of the teeth? Or are we to understand that some of them act on the animal portion, some on the earthy, and some, or all, on the enamel? Just turn to the index of almost any chemical text-book, and ask yourself if it is proved that nearly all of the acids there named act readily upon the teeth. Do carbonic acid, tannic acid, and scores of others that might be named, act *readily* upon the teeth? This expression, and many others that might be quoted from various writers, show a professional longing for, rather than an attainment of the truth in regard to this matter.

Now, for convenience, let us assume that dental caries is produced by the action of acids. The question still arises, what acids? Are many acids, or only a few, concerned in its production? One of the laws of combination teaches us that chemical compounds are definite in their nature. Chemical action is always definite. When an acid combines with an alkali, or base, a definite compound, called a salt, is formed. When a different acid



unites with this same base, a different salt is formed. Each salt, each chemical compound of any kind, is distinguished from all others, by characteristics peculiar to itself. It is unlike all other substances, in some respects. Each chemical result differs from all other chemical results. Of course, then, a great variety of chemical reagents will produce a great variety of chemical reactions.

Let us now inquire as to the various characteristics of those chemical actions which result in what we recognize as dental caries. Do we here find a great variety of appearances? Or is it not well known that the phenomena of caries are so few, and so circumscribed, that, by common professional consent, but three or four varieties of it are recognized? We find one variety often called "white decay," and another that is brownish in color, and a third that is very properly designated as "black decay." These differ in other respects as well as in color. In the white variety all the components of the teeth are acted on, and disintegrated, as far as the disease extends. In the second variety, the earthy portion of the tooth seems to be removed, while much or all of the animal portion remains, which is conclusive evidence that the chemical agent, whatever it may be, forms soluble compounds with the earthy materials. In the "black decay" there is less disintegration of the tooth substance than in either of the other varieties; and it progresses less rapidly than either of them. The physical characteristics of this variety, aside from the chemical, would indicate that the chemical agent principally concerned in its production forms, mainly, insoluble compounds with the constituents of the tooth. Then, there is a fourth variety, commonly called "chemical abrasion," in which the entire tooth substance is *removed*, as far as the disease extends. It is evident that the agent producing this, dissolves or forms soluble



compounds with both the animal and earthy materials of the tooth.

Unless we conclude that chemical compounds are not definite in their nature, and that many reagents may produce but a few reactions, we are forced to the conclusion that dental caries, as observed and recognized, results from the action of but few substances on the teeth. It is very probable that each *distinct* variety is produced by the action of a single agent, and, invariably, by the same agent. I am well aware that more than one variety may be found in the same mouth, at the same time, and in close proximity; and consequently, any given case of caries may partake of the characteristics of more than one variety. It is not uncommon to find "white decay" attacking a tooth in a cavity primarily affected with the brown, or colorless variety. But every practitioner is familiar with unmixed cases, representing all the four classes specified.

The physical characteristics of decay depend much on the texture of the teeth affected; but they are dependent, also, on the nature of the compounds formed by the union of the destroying agent with the constituents of the teeth. The degree of concentration of the chemical agent has also a modifying influence. When much diluted, its action is almost solely in obedience to its strongest affinity. For example, if nitric acid were the agent, when concentrated it would act energetically on the animal as well as on the earthy materials of the teeth; but when much diluted its action would be almost confined to the latter.

The chemical characteristics of decay, however, depend almost exclusively on the character of the agent producing it. The truth of this appears evident, when we reflect that bad teeth and good ones are composed of the same chemical substances. Marble and chalk are alike in chemical composition, but not in physical structure; and,



though an acid acts more rapidly on the latter than on the former, yet the result of the action is the same. An acid, too, will act with more energy on a soft, porous tooth, than on one of firmer texture ; yet the chemical results are the same. It is safe to conclude, then, that as there are but few *results* in the chemical actions attendant on dental caries, there are but few chemical agents immediately concerned in their production.

It is not to be inferred from the above that but few agents are capable of injuring the teeth by chemical action. Many acids used in food or as medicines are capable of doing injury to the teeth. But no one need suppose that an acid, even though considerably concentrated, brought occasionally in contact with the teeth, is the immediate cause of caries. Every close observer will conclude that caries is the result of an agent acting slowly and steadily in the accomplishment of its work. He will be apt to infer that this agent is either formed by chemical action within the mouth, or is eliminated therein, either as a secretion or an excretion, and that it quietly performs its disastrous deeds as fast as formed or eliminated. The application to the teeth of an acid capable of acting chemically on them, facilitates or predisposes to the production of caries ; and this it may do, without this acid being the *immediate* cause of the decay. A tooth may be fractured, or its enamel may be removed, by mechanical means ; and, as the dentine is thus exposed, the tooth is more liable to caries than before the exposure. But no one supposes that the mechanical action which exposes the dentine is the immediate cause of the caries. The dentine would remain sound and healthy, did not some chemical agent attack it. In like manner, in the administration of acids as food or medicine, the teeth may be so corroded as to expose the dentine, and render it as liable to the action of the carious agent as in the former case ; or if the dentine



is not exposed, the enamel may be roughened, either mechanically or chemically, so as to afford a lodgment for organic matter, which, by decomposition, may generate one of the acids immediately concerned in the production of caries. On this principle, acid medicines and acid foods may indirectly, but not immediately, cause caries. The same remarks will apply to acids brought in contact with the teeth by eructation or vomiting.

If this view is correct, the investigation of the subject of dental caries is brought within a narrower compass than many suppose. The first step is to inquire what acids, in health and disease, are liable to be secreted or excreted, so as to be brought regularly in contact with the teeth. The second is to ascertain what acids are liable to be formed within the mouth, by fermentation or otherwise. And the third is to discover what ones of all these are capable of producing the phenomena of dental caries. There is but little room to doubt that, at least, each of the first three varieties is the result of a *specific* agent. And if these unstudied remarks should lead others to investigate this matter, I will be satisfied.



## “BUT ONE KIND OF DENTAL CARIES.”

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HEALTH is a unit, which is about the same as saying health is health. But is disease a unit? Persons have been found to give an affirmative answer to this question. But such persons agree that while there is but *one* right way, there may be *many* wrong ones. A normal tooth is a normal tooth; but it is capable of undergoing a variety of abnormal changes, differing in nature as well as in degree of intensity. And what of it? Nothing, certainly, except that in a prominent place in a well-known journal this remarkable statement is found:

“Some authors have labored to divide caries into several different kinds, but there is but one kind—the only difference is in the degree of intensity with which it makes its progress in different individuals and at different periods of life, varying with the habits and constitution of the patient.”

Notwithstanding this sentence, it is probable that the writer believes that, whatever may be predisposing causes, chemical corrosion is the *immediate* cause of dental caries. If he does not, space cannot be spared just now to argue with him. It will do for the present to assume as true that which is believed by all scientifically educated dentists. And if it is true that chemical corrosion is the cause of dental caries, then there must be as many varieties of corrosion as there are corrodents; for chemical action is definite, alike in its nature and its results. If but one substance capable of corroding the teeth gets in contact with them, then there can be but one kind of corrosion of



the teeth; if two, there must be two kinds; and if three, three kinds; and so on for quantities. And the results of chemical corrosion do not depend on "the degree of intensity with which it makes its progress," but on the nature of the corrodent and the object corroded. If sulphuric acid corrodes a metal, the metal is oxydized, and a sulphate of the oxyd is formed. This is the inevitable result, let the "degree of intensity" be what it may.

That which is true of the corrosion of a metal is true of the corrosion of a tooth. That different agents must produce different results, is simply a chemical truism. If hydrochloric acid corrodes tooth-bone, in the mouth or out of it, it decomposes the carbonate of lime, while it is decomposed itself; and the results are carbonic acid, water, and chloride of calcium, the latter one of the most soluble of salts. At the same time, it forms a soluble compound with, or dissolves, the subphosphate, while it scarcely interferes with the composition of the animal matter of the bone. But if sulphuric acid is the corrodent, the carbonate is decomposed; but instead of the highly soluble chloride, as above, the almost insoluble sulphate of lime is formed, the subphosphate is not dissolved, and the oxygen and hydrogen are taken from the animal portion, leaving the carbon and nitrogen to dispose of themselves. In short, there is more *decomposition*, but less *disintegration* than when hydrochloric acid is the corrodent. These illustrations may suffice for the present.

If the doctrine of the sentence quoted above be true, it follows that but one chemical agent is present in the production of dental caries, and it is probable the writer will have as much difficulty in persuading the profession that this is true, as he would have in convincing us all that there is but one kind of metallic corrosion. He would have this advantage in maintaining the two positions, that "but one kind" of reasoning would be necessary.



Think of him lecturing chemists and druggists after this manner :

Some authors have labored to divide the preparations of iron into several kinds, but there is but one kind—the only difference is in the degree of intensity with which the corrosive agent makes its progress in different specimens, and at different seasons of the year, varying with the source and texture of the metal.

And though this imaginary lecture was delivered with much earnestness, and great apparent sincerity, and even though every look and action of the speaker showed that he expected to be believed, the druggist's clerk, like an infidel wretch, shook his head, and inwardly resolved that, notwithstanding all this, if a patron asked for persulphate of iron, he would not give him the sesquioxyd, even though it is prepared with less inconvenience.



## DENTAL CHEMISTRY OF THE MOUTH.

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As the morbid condition which the dental surgeon is most frequently called upon to treat is now universally conceded to be the result of chemical action, and as the most important to be noticed, in replacing the parts lost by its devastations, is the selection of such materials as will neither act chemically on any of the substances within the mouth, nor be acted upon by them, it follows that the chemistry of the mouth, in all its bearings, invites our closest study and the most careful scrutiny. We propose, therefore, to devote some attention to the subject, without any attempt at originality or depth of thought. If we can present the subject in such light that a majority of our readers can comprehend our meaning, and especially if we can render our remarks practically useful, our highest ambition will be gained. And we may as well state here that we do not intend to be either very systematic or technical. We know that many of our readers are not practical chemists, and while they think and reason so clearly for us on other subjects, it will be but small recompense if we can be useful to them in this.

In the discussion of this subject we will avail ourselves of the light of experiments and of the thoughts of others.

The teeth are composed of three distinct anatomical elements: the *enamel*, the *cementum* or *crusta petrosa*, and the *dentine*. These differ from each other both in physical structure and chemical composition. Each is composed of animal matter and earthy salts. The dentine constitutes the principal bulk of the tooth, and will, therefore, receive our first attention.



The proportions of organic and inorganic matter vary with the constitution, temperament, and age. As life advances, the calcareous matter is increased; hence any two analyses are not likely to agree in all particulars.

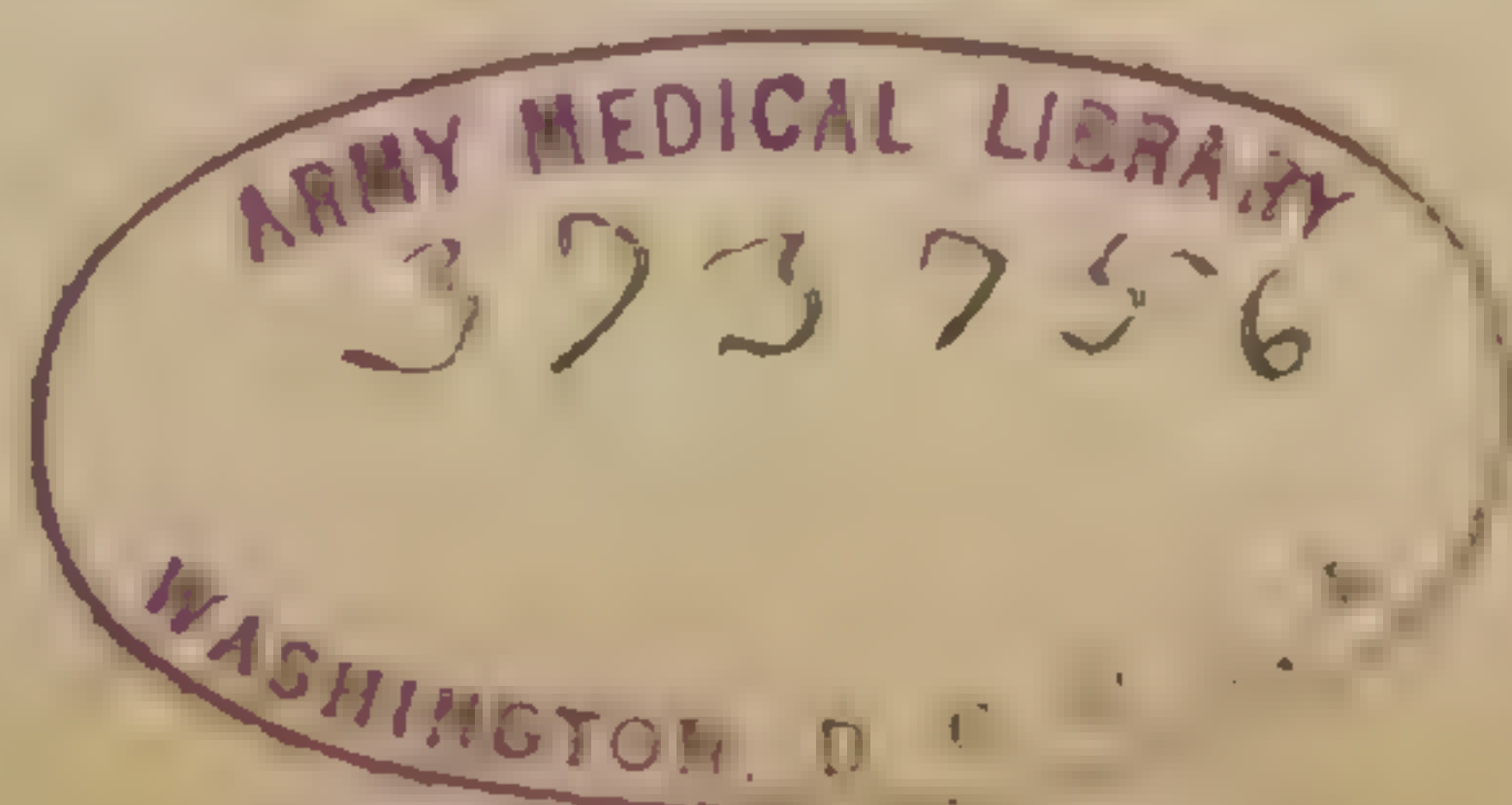
Berzelius found in human dentine:

Cartilage and vessels.....	28.0
Phosphate of lime, with fluoride of calcium.....	64.3
Carbonate of lime.....	5.3
Phosphate of magnesia.....	1.0
Soda, with chloride of sodium .....	1.1
Loss .....	0.3

It is needless to multiply analyses, as this is doubtless sufficiently reliable for practical purposes. But that we may the better understand the subject, it may be profitable to consider briefly the chemical characteristics of each of the above ingredients.

**Phosphate of Lime**, as its name imports, is composed of phosphoric acid and lime. As the acid and the base unite in several proportions, more than one phosphate is formed by their union. As these differ in important respects it is proper to know which of them is a constituent of tooth-bone. Phosphoric acid is formed by the union of about 32 parts of phosphorus with 40 of oxygen. Its formula is  $\text{PO}_5$ . Lime is composed of 20 parts of the metal calcium and 8 of oxygen, and its formula is  $\text{CaO}$ . Now, the phosphate found in bony tissues is composed of 224 parts of lime united with 214 of the acid, and its formula is  $8\text{CaO} + 3\text{PO}_5$ . This is not the neutral phosphate, but is called the subphosphate, or more frequently the "bone phosphate." It may be obtained pure by calcining teeth or bones in a crucible to complete whiteness, reducing to powder, and digesting with hydrochloric acid. The bone phosphate is dissolved in the acid, and may be precipitated from it by caustic ammonia.

The subphosphate thus obtained is a white, tasteless,





inodorous powder, insoluble in water, but soluble in acetic, nitric, and hydrochloric acids. It may be precipitated from any of these solutions by ammonia, potash, soda, or their carbonates. It is a very permanent compound, being fused, but not decomposed, by intense heat.

**Carbonate of Lime** is composed of carbonic acid and lime. Carbonic acid is so well known that it need not be described. Its symbol is  $\text{CO}_2$ ; and hence, the formula of this carbonate is  $\text{CaO}, \text{CO}_2$ . It exists abundantly in the forms of chalk, marble, etc., and is very readily decomposed by most acids and by heat.

**Phosphate of Magnesia** is composed of phosphoric acid and magnesia. Its quantity in the tooth is not sufficient to modify, practically, any chemical action liable to take place in the mouth.

**Soda** is the well-known alkali, composed of 8 parts of oxygen combined with 23 of the metal sodium. It possesses a strong affinity for acids; but its quantity is so limited that it need scarcely be mentioned in considering the chemical actions by which the tooth is destroyed.

**Chloride of Sodium** is the common table-salt; and, though it sometimes plays an important part in the chemistry of the mouth, yet but a trace of it is found in dentine, and hence we will omit its consideration for the present.

The *cementum* or *crusta petrosa* contains more organic matter, in proportion to its inorganic, than dentine. Its composition, according to Lassaigne, is:

Organic matter.....	42.18
Phosphate of lime.....	53.84
Carbonate of lime.....	3.98
	<hr/>
	100.00

As the *cementum* has less density than dentine, it is more readily acted on by chemical agents; but while the



mouth retains its normal structure, it is not exposed to either the ordinary or incidental chemical influences within the mouth. Its constituent substances were explained in speaking of dentine.

The *enamel*, according to Berzelius, is composed of:

Phosphate of lime, with fluoride of calcium.....	88·5
Carbonate of lime.....	8·0
Phosphate of magnesia.....	1·5
Membrane, alkali, and water.....	2·0
	<hr/> 100·00

The extreme hardness of enamel protects it from the action of chemical agents, which would act readily on substances of the same composition having less density.

The animal portion of the tooth is possessed, in general, of the same chemical composition as other organic parts of the body. Albumen, fibrin, and casein constitute the principal bulk of animal bodies. It is now generally conceded that these are but modifications of one and the same compound, which is denominated *protein*, and which is regarded as the starting-point of all tissues. Its composition, according to Mulder and others, is represented by the formula  $C_{40}H_{31}N_5O_{12}$ . Its equivalent, on the hydrogen scale, is 442·4.

The organic tissue of bone, cartilage, etc. is generally included under the term *gelatin*; but, strictly speaking, this substance does not exist in the animal tissues, but is formed from them by the action of boiling water.

The organic portion of the tooth is liable to decomposition from various sources. If its vitality be lost, of course it undergoes spontaneous decomposition, unless prevented by antiseptic measures. The alkalies form with it soluble compounds; and many of the acids, if concentrated, or in their nascent state, are capable of decomposing it, by virtue of their affinities for some of its constituents.



Water, of course, is an ingredient of the vital portion of the tooth, as of all the other organic tissues. In some of the chemical phenomena which occur in the mouth, it plays an important part. Every one knows that it is composed of oxygen and hydrogen—eight parts of the former to one of the latter.

Having now briefly noticed the chemical structure of the teeth themselves, the next thing is the chemical characteristics of the various agents, either ordinarily or incidentally brought in contact with them, which are or may become capable of acting injuriously on them. The first that we will notice is the saliva.

**Saliva.**—The saliva has of late years received much attention from chemists, yet the subject is still somewhat complicated and obscure. It is not our purpose to give a full or lengthy notice of it. “According to Dr. Wright, pure saliva is a limpid fluid, having a faint blue tinge, and a slight degree of viscidness. It is perfectly uniform in consistence, and unobscured by frothiness or flocculi.”

The saliva contains but a very small quantity of solid matter. This is composed of spirit and water-extracts, ptyalin, fat, albumen, sulphocyanogen, and a variety of salts. These salts are usually phosphates, carbonates, lactates, traces of sulphates, and chlorides.

Berzelius found in 1000 parts of human saliva :

Water.....	992.9
Ptyalin.....	2.9
Mucus.....	1.4
Extract of flesh, with alkaline lactates.....	.9
Chloride of sodium.....	1.7
Soda.....	.2

Simon found in 1000 parts of his own saliva :

Water.....	991.22
Solid constituents.....	8.77



These solid constituents were :

Fat containing cholesterin.....	·52
Ptyalin, with extractive matter.....	4·37
Extractive matter and salts .....	2·45
Albumen, mucus, and cells .....	1·40

The saliva varies very considerably in its composition, and no doubt many changes may take place without a forfeiture of its right to the title of *normal* saliva. Then, its abnormal states are represented by a great variety of modifications.

The chemical agents in healthy saliva most important to be noticed, at least as far as the *dental* chemistry of the mouth is concerned, are water, the chlorides, soda, and sulphocyanogen.

Any one who will take the time and pains can, by observing a few plain directions, test the saliva in any given case with sufficient accuracy for practical purposes. And the first thought that strikes the operator is likely to be: "Is the saliva acid, alkaline, or neutral?" This can be usually answered with sufficient accuracy by testing with prepared litmus-paper. And every practitioner should have a supply of "test-papers" in his case ready for use on any occasion that may require them. Nor should he rest satisfied with merely a general examination; but if, for example, he discovers acidity in the mouth, he should go on to ascertain its source, whether it be in the mucus, the saliva, or in decomposing foreign substances. If it be in the saliva, he should ascertain whether it be in the secretions of all the glands, or confined to but one or more of them. All this he must know, and much more, before he can be at all prepared to treat intelligently any case in which the secretions of the mouth are abnormal.

The saliva may be tested for albumen by heat, which, by coagulating the albumen, if present, will render the



liquid turbid. Sulphocyanogen is indicated by the redness produced by the addition of perchloride of iron. Simon says: "With a view to separate the constituents of the saliva, I evaporated a known quantity to dryness, and thus determined the water. I then treated the residue with ether for the purpose of extracting the fat; and with water, in order to take up the ptyalin, extractive matter, and salts. The insoluble residue that had resisted the action of ether and water consisted of albumen and mucus. Another portion of the saliva was decanted from its precipitate, evaporated to a small residue, and the ptyalin, with a trace of extractive matter, precipitated by alcohol."

The specific gravity of healthy saliva varies considerably. It is generally, if not always, a little above that of water.

Pure saliva absorbs oxygen, which contributes to its digestive power. Dr. Wright found that saliva which had been exposed some hours to an atmosphere of oxygen, converted a much greater quantity of starch into gum and sugar, than saliva not so exposed.

**Merbid Saliva.**—The saliva is liable to a variety of abnormal modifications. It is not our purpose at present to notice all of these conditions, nor any of them at any great length. As already intimated, a free acid, or more than one, may be found in the saliva. The lactic is the most common; but acetic, hydrochloric, oxalic, uric, and others are sometimes found. The acid reaction is easily detected by test-paper. Normal saliva, being alkaline, imparts a blue tint to red litmus-paper, while this reddens blue paper. If on evaporation to dryness, the acid reaction is destroyed, it is evident the free acid is not the *lactic*, which is the most frequently found. Hydrochloric acid may generally be detected by its action on a fresh solution of nitrate of silver; but as the soluble chlorides, if present, would produce similar results, the acid may be



separated from them and from most of the other constituents of the saliva by distillation. Its quantity may then be estimated by the amount of chloride of silver which constitutes the precipitate. Chloride of silver is represented by the formula  $\text{AgCl}$ , and is composed of 108 parts of silver to 35 of chlorine. The 35 parts of chlorine require one part of hydrogen to form hydrochloric acid; hence when the weight of the chloride is ascertained, the calculation is easy.

According to Dr. Wright: "The saliva is impregnated with *lactic acid*, chiefly in gout, rheumatism, ague, diabetes, and gastro-enteritis; with *acetic acid* in aphthæ, scrofula, scorbutus, small-pox, protracted indigestion, and after the use of acescent wines; with *hydrochloric acid* in simple gastric derangement from immoderate or improper animal food; and with *uric acid* in gouty affections." He tells us also that acidity of the saliva is likely to occur in fevers, both typhoid and inflammatory, in measles, phthisis, venereal disease, many skin diseases, catarrhs, mumps, and in tedious dentition of weakly children.

**Mucus.**—The internal parts of the animal system which are directly connected with the external, are covered by a soft, velvety, and very vascular tissue, called the mucous membrane. This membrane is a continuation of the skin, and therefore all parts of the system are enveloped in one and the same tegument, its internal and external portions differing very materially in regard to their exposed surfaces. The exposed surface of mucous membrane is covered by a delicate layer of epithelium. The membrane derives its name from the qualities of the fluid with which it is moistened, which fluid is a regular secretion, and serves to protect the delicate membrane from the action of irritants. This fluid is viscid, tenacious, sometimes colorless, but mostly turbid, of a faint yellow



or grayish-white color. It is secreted in but limited quantities when the membrane is in its normal condition; but in a state of irritation, the secretion is greatly increased.

It is difficult, if not impossible, to ascertain precisely, either the physical or chemical properties of normal mucus, or even of abnormal. The normal can only be obtained in limited quantities; and the transition from normal to diseased mucus is so gradual and indefinite that it is impossible to define the precise point at which the change takes place. And besides, it is almost impossible to obtain mucus uncontaminated with other substances. It is little wonder then that Simon remarks: "Hence it is not very easy to form a distinct conception of what normal mucus really is."

We have said that the mucous membrane is a continuation of the skin; and, like the skin, it is constantly undergoing a desquamation, a separation of cuticular scales taking place in the one, a throwing off of epithelium cells in the other.

The specific gravity of healthy mucus, when fresh and recently secreted, is greater than that of water; accordingly it sinks in that fluid, unless prevented by the presence of air bubbles or other causes.

It was once generally regarded as characteristic of mucus to float in water; and this test was considered sufficient to distinguish it from pus; but dried mucus, or fresh mucus from the intestines or urinary bladder, and even that from the bronchial and nasal cavities, when deprived of air bubbles, sinks rapidly in that fluid.

Fresh, liquid, transparent mucus, from the nasal or bronchial membrane, is found, by examination with the microscope, to consist of a fluid containing minute, rounded, or elongated granular bodies, called mucus-corpuscles, and a more or less abundant supply of epithelium cells. Ac-



according to Simon, a finely granulated substance also pervades the fluid.

The mucus of the mouth is obtainable only in such limited quantities, besides being mingled with other substances, that great difficulty is experienced in obtaining a satisfactory knowledge of its chemical properties. Accordingly, nasal, bronchial, and intestinal mucus is generally selected in conducting experiments with this substance. Mucus being secreted by the same membrane, wherever found, is likely to have the same general properties.

Simon states that the epithelium cells "are not affected by the addition of water, or of dilute acids; they disappear, however, under the influence of caustic alkalies or concentrated acids." These cells are also unaffected by the ordinary earthy and metallic salts. "The mucus-corpuscles," says Simon, "are very differently acted on. Dilute acetic, oxalic, and tartaric acid speedily deprive the capsules of the mucus-corpuscles of their granular appearance. The corpuscles themselves become round and transparent; the nuclei become apparent, the capsules at length disappear, and the nuclei frequently divide into several granular bodies, so that in place of the mucus-corpuscles previously visible, there are at last only two, three, or more rounded granules to be seen."

Simon states that the liquid portion of mucus always exhibits a decidedly alkaline reaction; but this is, at least, doubtful. Indeed, there is scarce a doubt that morbid mucus often has a decided acid reaction. In analysis of mucus the acids are included in the extractive matters.

When distilled water is added to a clear fluid mucus a coagulation is perceived which soon is deposited as a fine granular precipitate. The same precipitate, more copious and tenacious, is thrown down by acetic, or almost any



weak acid. This precipitate is not thrown down by the alkalies or their carbonates.

The precipitate thus obtained is supposed to be the characteristic chemical constituent of mucus, and is hence called *mucin*.

As mucin is soluble in solutions of the alkalies, and as it is precipitated by removing the alkali by an acid, or even by water, it seems rational to conclude that in normal mucus it is held in solution by an alkali.

The fluid portion of mucus also contains chloride of sodium, lactate of soda, and traces of a few other salts. We know but little, positively, of the contents of the mucus-corpuscles. Simon says: "In all probability they contain a fluid in addition to their nuclei. The fat that occurs in mucus is probably contained in the corpuscles; for no fat-vesicles are generally observed in fresh mucus, but after the solution of the corpuscles by the addition of acetic acid, a few fat-vesicles make their appearance."

It is probable that fat and albumen, though often found in normal mucus, are not essential constituents of it. By an analysis of nasal mucus Berzelius found in 1000 parts:

Water.....	930.7
Mucin.....	53.3
Alcohol-extract and alkaline lactates.....	3.0
Chlorides of sodium and potassium.....	5.6
Water-extract with traces of albumen and phosphates	3.5
Soda, combined with mucus.....	3.9
	<hr/>
	1000.0

We have no very thorough and reliable analysis of buccal mucus. It is almost impracticable to obtain mucus from this source in such condition and quantity as will be satisfactory. The analysis of buccal mucus by Jacobowitsch, as quoted by Piggot, is as follows:



Water..... 990.02

Solid matters:

Organic matter soluble in alcohol.....	1.67	
“ “ insoluble “ .....	2.18	
Fixed salts.....	6.13	9.98
		<hr/> 1000 00

From the preceding observations we may conclude that mucus contains epithelium cells, mucus-corpuscles, mucin, small quantities of extractive matters, alkaline lactates, chlorides of sodium and potassium, a little phosphate of lime and carbonate of soda, usually a small quantity of fat, and sometimes a trace of albumen.

Simon adopts the following method of separating these substances in analysis:

“A known weight of mucus must be washed with distilled water and evaporated to dryness on the water-bath. The residue must be finely triturated, and repeatedly extracted with boiling ether, in order to remove the fat; it must then be boiled in spirit of 0.91 as long as any additional matter is dissolved. The spirituous solution must be evaporated to a small syrupy residue, and alcohol of 0.85 added, in order to precipitate any dissolved mucin, caseous matter, water-extract, and pyin: the alcoholic solution, containing the alcohol-extract and lactates, is also to be evaporated. The portion undissolved by boiling spirit of 0.91, consists of mucin with cells, and traces of albumen, if the previous quantitative investigation has shown that this substance is present.

“In order to determine the salts, a portion of the dried residue must be submitted to incineration. It is difficult to obtain a white ash in consequence of the fusion of the salts. The chlorides may be extracted with spirit; the residue must then be treated with acetic acid, in order to convert



the carbonates, which have arisen from the incineration of the alkaline lactates into acetates, which may be extracted with alcohol. Anything that still remains is composed of phosphates and perhaps sulphates, in very minute quantity, together with traces of iron and silica."

Irritation of the membrane greatly increases the secretion of mucus. This is witnessed in the nasal and bronchial secretions during catarrhal affections, and is often as observable in inflammatory diseases of the mouth. In all these conditions, the mucus is considerably changed. At the onset of the attack, it is thinner than usual, but becomes thicker as the disease progresses; the mucus-corpuscles are increased in number and the epithelium cells diminished. Simon says "the reaction continues alkaline; in fact, in most cases it is more strongly so than in the normal state." This is not according to my own observation; indeed, I have usually found an acid reaction in such cases; but my observations have not been sufficiently extensive to determine what is the rule. There is usually an excess of albumen and an increase of fat. According to our own observation, there is also a very perceptible increase of the soluble chlorides in the early stage of inflammation of the mucous membrane. Decomposition of these chlorides may take place from adventitious causes; and if so, the nascent chlorine will form hydrochloric acid with the hydrogen of the water contained in the saliva. This may account sometimes for the acid reaction observed.

Much obscurity rests on this subject, and many difficulties lie in the way of its thorough investigation. We hope those who have the time and talent will undertake the task. In our next article we will endeavor to describe the source and action of some of the principal acids which are likely to exert an injurious influence on the teeth.

At the close of our article on **Mucus**, we proposed in



our next to consider the various articles which, in ordinary life, exert an injurious chemical influence on the teeth. We did not then properly estimate the magnitude of our promise, nor appreciate the numberless difficulties that lay in our way. Having come to our senses in this respect, we now only propose to do something, if we can, toward the fulfillment of our promise.

To properly understand any chemical action to which the teeth are subject, it is necessary to bear in mind their texture and composition, and to consider the chemical properties of at least their principal constituents. It must also be remembered that the teeth are endowed with vitality. As dental caries, the most common disease of the human race, is now universally conceded to be the result of chemical action, the importance of this subject is at once manifest. The time is not far distant when in every case of recent caries the enlightened practitioner will be able, by the character of the decay and the habits and constitution of the patient, to detect and identify the agent or agents producing the disease. Any practice short of this knowledge must be at least to some extent guesswork, and is, although the best we can now do, empirical practice.

The fact that an active alkaline base is the principal inorganic ingredient of the teeth, would indicate clearly that their great danger lies in the presence of acids; and all experience demonstrates the truth of this inference. This danger is also greater from the fact that the principal salt of this base, present in the tooth substance, combines with several acids without undergoing decomposition.

It is evident that the acids do not all act alike on the teeth. Indeed, some exert no influence whatever on them, while others act with great energy on each and all of their constituents. It would be an endless task to consider all the substances which are capable of exerting an



injurious chemical influence on the teeth; and, perhaps, it would be as unprofitable as endless. All that is now aimed at is an accurate account of the various substances which ordinarily act chemically on the teeth—which produce caries and “chemical abrasion.”

But without further preface, we will proceed to notice some of the chemical agents alluded to.

**Nitric Acid.**—This acid is composed of five equivalents of oxygen united with one of nitrogen. Its symbol is, therefore,  $\text{NO}_5$ . It acts with great energy on all the constituents of the tooth. Its great energy of action depends on a variety of circumstances. As an acid, it unites energetically with bases, and will, therefore, take the lime and kindred bases from the weaker acids. From its ready decomposition, it affords oxygen, in its nascent condition, for the destruction of oxydizable substances. Its action on the tooth may be thus briefly described: it dissolves the phosphate of lime, decomposes the carbonate, setting the carbonic acid free, and forming nitrate of lime, and destroys the organic portion, producing a highly softened state of the carious matter. In fact, it is a prominent, if not the principal agent in the production of the “white decay.”

But the question naturally arises, Is an agent so destructive in its tendencies likely to come in contact with the teeth, and if so, under what circumstances? The question is important, and the answer, perhaps, difficult.

It is well known that this acid is frequently administered as a tonic; and it is a lamentable fact that far too little attention is paid to the prevention of its injurious effects on the teeth in such cases, but this will by no means account for the frequency with which it evidently injures the dental organs. A few thoughts in regard to its formation may throw some light on the subject.

It is a singular fact that though nitrogen and oxygen



manifest but little affinity for each other, yet they unite in various proportions, forming at least five well-known distinct compounds. It appears, however, from a variety of circumstances, that their tendency is to unite in the proportions which form nitric acid. The protoxyd is readily decomposed, and yields nitrogen, oxygen, and *nitrous acid*. The binoxyd, if brought in contact with the atmosphere, takes from it two equivalents of oxygen, and also becomes *nitrous acid*, or  $\text{NO}_4$ . Hyponitrous acid,  $\text{NO}_3$ , on admixture with water, is converted into nitric acid and binoxyd of nitrogen, thus:  $3\text{NO}_3 = \text{NO}_5 + 2\text{NO}_2$ , in which case the latter will be converted into nitrous acid, which, in the presence of water, is converted into *nitric acid* and binoxyd of nitrogen.

It follows from this that, if oxygen and nitrogen unite at all in the mouth, let the proportions be, at the first, what they will, nitric acid must be the ultimate result—as air and moisture, the only agents necessary in the transformation, are here always present.

The reader will now think of the mucus, and particles of nitrogenous food lodged about the teeth undergoing decomposition, and yielding nitrogen to the oxygen of the atmosphere, or of the fluids of the mouth, and will conclude that all is explained. Well, perhaps it is. But let us consider. Nitrogen is emphatically a “conservative” element, and manifests but little tendency to unite with anything, and especially with oxygen. It is probable, therefore, that these two elements unite indirectly. It should be borne in mind that organic nitrogenous bodies contain hydrogen and oxygen, as well as nitrogen. Consequently, by their decomposition, these elements are all liberated. The mutual affinities of hydrogen and nitrogen take precedence, and the result is the formation of ammonia,  $\text{NH}_3$ . But ammonia, exposed to the action of oxygen,



is always decomposed; an oxyd of nitrogen being formed, and of course *nitric acid* is the result.

With this view of the case, and from the fact that many persons permit the buccal mucus, as well as particles of nitrogenous food, to remain around, upon, and between the teeth, till decomposition is effected, it is not surprising that the white variety of dental caries is so frequently found.

Nitric acid is also sometimes formed in the mouth by the agency of galvanic action. When two metals are placed in the mouth in proximity to each other, and the fluids of the mouth are capable of acting on one of them, galvanic action is established. And if they are so situated that the mucous membrane forms a connecting conductor, by being in contact with both, especially if the metallic surfaces be considerable, a current is established, sufficient to decompose any of the binary compounds contained in these fluids. The liberated nitrogen, hydrogen, and oxygen will result, as above, in the formation of ammonia, and then nitric acid. But galvanic action in the mouth is more likely to develop hydrochloric than nitric acid. This will be noticed again.

**Sulphuric Acid.** — Sulphuric acid is composed of 16 parts of sulphur united with 24 of oxygen. Its symbol is, therefore,  $\text{SO}_3$ . In addition to those properties which characterize it as an acid, it is a powerful caustic poison, and promptly destroys the various tissues with which it comes in contact. Its chemical action on ordinary tissues depends principally on its affinity for water, but not altogether; for it has the ability to coagulate and unite with albumen, and to dissolve fibrin. In common with other acids, it has a strong affinity for alkaline bases.

With these properties in view, let us examine its action on the teeth.

The affinity of this acid for water is so energetic that it



seems even to force its elements to forsake favorite combinations, and to unite with each other, that it may be gratified. For example, a cork in a bottle of sulphuric acid becomes dark colored, and is really charred. Now, a cork, like other wood, is mainly composed of carbon, hydrogen, and oxygen—the two latter being in the proper proportions to form water. Their affinity for each other, quickened by that of the acid for the result of their combination, causes them to forsake the carbon, unite with each other to form water, and then combine with the acid. The same phenomena occur when it acts on animal tissues; for they are principally composed of the above-named elements, with the addition of nitrogen. Accordingly, “black spots are frequently observed in the stomachs of those who have swallowed the acid.” Now, that its slow and prolonged action on the gelatinous portion of the tooth would result in its carbonization, is a conclusion justified both by inference and experiment. But carbonized gelatin is “animal charcoal,” the color of which is a prominent characteristic of “black decay.”

The phosphate of lime in the tooth, which is not the neutral, but a subphosphate, is not soluble in sulphuric acid; nor is the acid capable of decomposing it, except in the presence of alcohol. It follows, then, that this acid does not break down the texture of the tooth to the extent that some others do, simply because it cannot unite with, or, under ordinary circumstances, decompose the principal earthy salt of which it is composed. And here we have a second characteristic of “black decay.”

It is now time to inquire whether at all, and if so, by what means, and under what circumstances, this acid is brought in contact with the dental organs.

Sulphuric, like nitric acid, is frequently administered as a medicine, and generally with criminal negligence in respect to its action on the teeth. But we cannot regard



this as the only or principal source of danger from this acid. If oxygen unites at all with sulphur, the tendency, under ordinary circumstances, is to the formation of sulphuric acid, as sulphurous acid, in the presence of moisture, is rapidly converted into the sulphuric. The whole question, then, is reduced to this, Is sulphur ordinarily present in the mouth, and liable there to become oxidized?

Albumen is a constituent of mucus, and is contained in many articles of food. Sulphur, if not a constituent of, is always united with albumen. Its ordinary presence in the mouth is therefore easily explained. Sulphur and oxygen unite directly, under various circumstances, as in the combustion of sulphur; but it is probable that the union here is effected by indirect means. Hydrosulphuric acid, or sulphuretted hydrogen, is one of the results of the putrefactive decomposition of albuminous substances. The breaths of our patients often bear ample testimony to its presence in the mouth. Now, the oxygen of the atmosphere rapidly decomposes this acid by taking its hydrogen to form water. The sulphur is therefore set free, and being in the nascent state, its affinities are increased in energy, and it also unites with oxygen, forming sulphurous acid,  $\text{SO}_2$ , which in the presence of the water of the saliva is rapidly converted into sulphuric acid, or  $\text{SO}_3$ .

The quantity of sulphur present in the mouth at any one time is very minute; and a great proportion of this is exhaled by the breath before it has time to undergo decomposition. And sulphuric acid, as already noticed, has a weaker affinity for the constituents of the tooth than some others. Hence "black decay" is not so frequently met with as some other varieties. And as from the nature of the chemical action the texture of the tooth is not so entirely broken up, the carbonized portion protects the



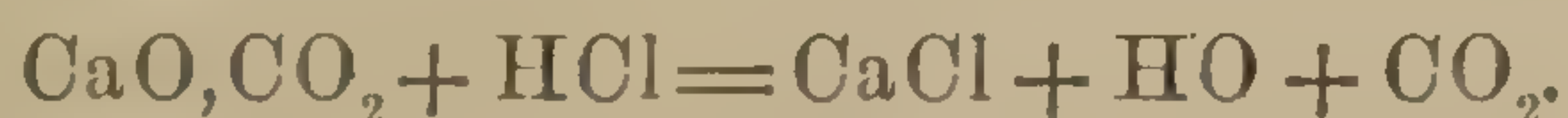
parts beneath it. This variety of decay therefore progresses less rapidly than others.

**Hydrochloric Acid.**—This acid is also called chlorohydric, and muriatic acid. It is composed of 35 parts of chlorine, united with 1 of hydrogen. Its symbol is HCl. Though its elements manifest a strong affinity for each other, yet it is very readily decomposed; and many of its chemical manifestations result from the action of one or both of its liberated elements. It is on this principle the acid attacks metals—being decomposed, the chlorine unites with the metal to form a chloride, and the hydrogen escapes with effervescence.

This acid, like those previously considered, is a caustic poison. Its escharotic power depends mainly on its affinity for water, which is very active, and on its ability to coagulate albumen. Its chemical action is generally inferior to that of the two acids just considered. It unites with bases, forming a class of salts called hydrochlorates; and sometimes it combines with a salt without decomposing it, or being itself decomposed. When concentrated, it dissolves animal tissues, but is in this respect far inferior to nitric acid. When much diluted and mixed with dried mucous membrane, it dissolves coagulated albumen, fibrin, etc., performing to all appearance an artificial digestion.

A careful observation of these properties will enable us to understand the action of this acid on the tooth.

The carbonate of lime and the acid are mutually decomposed. The results are chloride of calcium, water, and carbonic acid. The decomposition may be represented by the following equation:



The carbonic acid of course escapes as a gas, and the chloride, being very soluble, is dissolved in the saliva, and thus removed from the tooth.



The phosphate of lime (bone phosphate), though not decomposed by, is highly soluble in hydrochloric acid. It is dissolved, and is thus removed from the organic portion of the tooth.

We have seen that this acid, unless highly concentrated, is not capable of dissolving the animal portion of the tooth. As this concentration is not likely to take place in the mouth, it follows that, when hydrochloric acid is the cause of dental caries, the earthy portion is dissolved and removed, while the animal portion principally remains in the carious cavity. And here we have the prominent characteristics of a third variety of decay.

I have not taken into the account any of the earthy salts contained in the tooth, but the phosphate and carbonate of lime. They are present in such small quantities that they exert but little influence on any of the chemical actions which we have considered.

Hydrochloric acid is also administered as a medicine; and the remarks made on the preceding acids apply equally here. This acid is an ingredient of the gastric fluid, and is often present in abnormal quantities in the stomach, from which it is thrown into the mouth by eructation and vomiting. But we cannot thus account satisfactorily for the frequency with which the dental organs are evidently injured by this acid.

Though in its normal state the saliva is alkaline, yet in a variety of abnormal conditions it contains one or more free acids; and the hydrochloric is one of those most frequently present. It often originates no doubt in the decomposition of the soluble chlorides contained in the saliva and mucus. When the chlorine of these is liberated, it takes hydrogen from the water of the saliva, and this acid is a result of the union.

But sometimes hydrochloric acid is directly furnished by the salivary glands, either as a secretion or an excre-



tion. The system may contain just its normal quantity of chlorine, but if there be a deficiency of sodium or potassium the relative excess of chlorine is converted into hydrochloric acid. In this case the acid is secreted. Or the quantity of potassium and sodium may be normal, with an excess of chlorine. The excess will unite as before with hydrogen, and the acid will be excreted. At all events, this acid is usually found in the mouth when the mucous membrane is inflamed, as well as in patients who indulge in the excessive use of salted meats.

Galvanic currents in the mouth always result in the formation of this acid. The chlorides of sodium and potassium, present in normal mucus and saliva, are decomposed, and their chlorine unites with hydrogen derived from the water of the saliva. It is on this principle that we frequently find a decayed surface around a gold filling, which is in close proximity with one of a different metal, or with a silver plate or clasp. In such decays, the animal portion usually remains, while the earthy portion is removed, just as would be expected from the prolonged action of dilute hydrochloric acid.

In these observations we have endeavored to set forth the results of the ordinary uninterrupted action of these acids on the teeth; and we have seen that they are capable of producing the three varieties of decay usually described, though we by no means maintain that they are the only agents capable of causing these results. Their actions, and consequently the characteristics of decay produced by them, are doubtless much modified by circumstances. One of them may be the destructive agent in the commencement of the caries, and, in process of time, another may be developed, and exert its specific influence on the same cavity. Then the phenomena would of course be complex. Again, it should be remembered that a strong affinity for water is a property common to all of them. It



is possible therefore that carbonization, or blackening, may result from the action of any of them, yet it is by no means probable, at least with nitric acid.

But this paper is long enough. We originally intended to include in it the action of several organic acids, but our knowledge of them was too limited; and our experiments with them are not sufficiently matured to enable us to state results with any degree of confidence. Indeed, we find it difficult to conduct some experiments properly, on account of the frequent interruptions incident to the practical duties of the profession. We hope our readers will be patient; but if any one is not, we would be glad to have him turn his impatience to a good account, by anticipating us in our experiments, and giving his deductions to the profession.



## THE ACTION OF TOPICAL REMEDIES ON INFLAMED DENTINE.

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LOCAL remedies, generally the main dependence, and often the only resort of the dental surgeon, in the treatment of the diseases intrusted to his care, should be carefully considered and thoroughly understood by him. It is true that constitutional remedies are frequently required in the treatment of dental disease; and it is probable that we are often inclined to neglect the general, and rely on the topical treatment; yet, in inflammation of the dentine, from the nature of the tissue involved, it is evident that, in a majority of cases, the local is the treatment indicated.

The reader will please bear in mind that we now have nothing to say on irritable or exposed pulps, but that our remarks apply only to cases of exalted sensibility of the dentine.

For the sake of clearness, let us bear in mind that dentine, like other bony tissue, is composed of animal matter and earthy salts; that it possesses vitality; that its various constituent parts are capable of uniting chemically with other substances, and of undergoing chemical decomposition; and that it is sustained in its present state of existence by the combined influences of affinity, cohesion, and vital force.

Many difficulties lie in the way of reliable experiments,



in relation to the reactions which take place when chemical agents are brought in contact with dentine. It will not do to depend on their action on the tooth out of the mouth; for then the chemical affinity is not counteracted by vitality. Neither can we rely on the reactions set up by them with gelatin, albumen, or the various earthy salts of which dentine is composed; for, in that case, affinity is counteracted neither by vitality nor by the cohesion of the tooth. But, though we cannot learn all that we wish to know from these experiments, still we can learn much that is both interesting and useful.

By making due allowance, in each case, for the circumstances present to modify affinity, and by comparing the results with those we witness in the living teeth, as from time to time these agents are applied, we can arrive at conclusions much more reliable, as a basis for practice, than can be derived from any series of empirical experiments, even though it extends to millions of cases and claims the accumulated light of generations. Additional light may also be obtained by noticing the topical action of these remedies on the soft parts, and on the fluids of the system.

Local or topical remedies produce mechanical, chemical, and vital effects. It is of the chemical that we propose principally to treat. An agent whose action depends on affinity, even though not capable of producing a chemical change in the tissue to which it is applied, may still be properly ranked as a chemical remedy.

The action of a chemical remedy depends on the strength of its affinity for any or all of the constituents of the tissue on which it acts; on the texture of that tissue; on the nature of the resulting compounds, and on the presence or absence of modifying circumstances. Other things being equal, combination takes place with far more energy between liquids, than between a solid



and a liquid, or two solids. This is because the solid state prevents that closeness of contact necessary to an energetic manifestation of affinity, which acts only at insensible distances, and because the cohesion of the solid prevents that mobility of its ultimate particles which is necessary to combination. A soft or porous body is, therefore, attacked by an agent incapable of acting on a more dense one of the same composition. The relative action of a strong acid on chalk and marble will illustrate the point in consideration. The more dense the dentine, then, the greater is its capability of resisting chemical action.

The tendency of any substance having a strong affinity for organic matter, when in contact with living tissue, is to overcome the vitality of the part, and unite with one or more of its constituents. Substances capable of producing these changes are called *caustics* or *escharotics*. The destruction of vitality in one part produces a change in the vital actions of the surrounding parts, usually resulting in inflammation, or, at least, in exalted vitality. The whole action of these agents is, therefore, a *chemico-vital* process. The vital action thus aroused is in proportion to the amount of the disturbance, and to the vitality of the tissue. In the dentine, therefore, the chemical will generally predominate over the vital action; although in some of the soft parts, possessing abundant vitality, the reverse is often the case. The vital force may, in some cases, be able to prevent the escharotic action of these remedies, if they are diluted, or if the energy of their affinity for organic matter be in any way diminished. An immediate chemical change may be thus prevented, and the life of the part preserved; but the vital action is disturbed and altered. The active force is here still supposed to be affinity, and the effect is termed irritation. A prolonged application of weak chemical agents, however, will



finally produce slight changes in the composition of the tissues, without causing the death of the altered parts. A caustic may, accordingly, become either an irritant or an astringent, by dilution, or any other means by which the energy of its affinity for organized matter is lessened.

Water, albumen, fibrin, gelatin and the calcareous salts are the constituents of dentine, on which the various chemical remedies in use exert their action. And, it may be added, that agents inducing caries expend the force of their affinities on the same constituents. For example, nitric acid coagulates the albumen, dissolves the phosphate of lime, and decomposes the carbonate—in short, it acts chemically on every constituent of dentine, and its action ceases only when it is neutralized by the various combinations which take place. The same is true of hydrochloric acid, but not to the same extent; for a dilute solution of it spends its force almost entirely on the calcareous portion of the tooth, leaving the gelatinous portion behind.

The caustic alkalies act by their affinities for water, albumen, fibrin, and gelatin, which are very powerful; but, having little or no affinity for the earthy portion of the tooth, their action on dentine is less violent than that of most acids. The calcareous matter predominating so greatly, shields the gelatinous portions, to a great extent, from the action of such agents. The action of these agents on solid albumen, etc. is more like ordinary solution than definite chemical combination.

The character and texture of the compounds, resulting from the union of escharotics, or astringents, with any or all of the constituents of a living tissue, will, if carefully observed, do much to enable us to select the proper remedy for a particular case. The points important to be noticed are, whether the resulting compound is soluble or insoluble; and if insoluble, whether it be permanent,



or liable to rapid decomposition. On this point, experiments out of the mouth, with medicinal agents, on the various organic constituents of dentine, will give much important information. As an illustration of what is meant, let us compare the action of a caustic alkali with that of creasote, or a kindred substance. It is well known that the alkalies dissolve and hold in solution solid albumen, fibrin, and gelatin. Now, if one of these be applied to dentine, the animal portion of its substance is dissolved and removed, leaving the surface, with its increased vitality, amounting to irritation or inflammation, exposed to the action of the atmosphere, the fluids of the mouth, and any irritating agent that may be brought in contact with it. It is evident, then, that the exalted sensibility of dentine is not likely to be relieved by such agents, unless applied in quantity sufficient to dissolve the gelatin to such depth that the undissolved calcareous matter becomes a protecting surface.

On the other hand, the application of creasote, or a substance possessed of similar chemical properties, is followed by a union of the agent with the organic constituents of the dentine, resulting in the formation of an insoluble compound, retained in place by its mechanical connection with the calcareous portion of the tooth, forming a perfect protection to the parts beneath, which, by excluding all foreign substances, permits the newly aroused vital actions to perform their proper functions, in restoring the parts to health.

Another point to be noticed, in this connection, is the fact that the soluble compounds thus formed in dental cavities are liable to be absorbed, and thus produce the specific effect of the remedy on the whole body of the dentine, as well as on the pulp, while the absorption of the insoluble is, in the nature of things, simply impossible. And this leads to the important distinction, already alluded



to, between the insoluble compounds which are permanent, and those which are readily decomposed. The former, as already stated, cannot be absorbed, while the latter often are. Those formed by the action of tannin, or chloride of zinc, represent the one class—those from arsenious acid, or chloride of mercury, the other.

It is important to bear in mind that the agent possessing the strongest affinity for the constituents of dentine is not necessarily the most energetic in its action. Tannin manifests a powerful affinity for albumen, fibrin, etc.; but, as the resulting compound is insoluble and permanent, the very energy of the affinity prevents the full force of the remedy, by the almost instantaneous formation of a protective layer, which guards the subjacent parts against the further action of the drug. This remedy is, therefore, practically mild in its operation, its action being necessarily confined to a thin superficial layer, whether the quantity used be great or small; yet, to the extent of its combination with the organic constituents of the tissue, vitality is as thoroughly overcome as it could be by the actual cautery.

On the other hand, chloride of zinc, though manifesting less active affinity for the organic constituents of dentine, is, at the same time, a far more active remedy. This arises from several causes. It manifests a powerful affinity for water, and in removing this from the dentine, it prepares the way for its own admission, and at the same time is dissolved, and is thus in a better condition for exerting its other affinities, which are in no degree impaired by its union with the water. The compounds resulting from its union with albumen, etc. are more soluble than those formed with tannin, and consequently present a feebler barrier to the action of the remaining portions of the drug. The combination taking place less rapidly, affords time for the agent to penetrate the dentine



to a greater depth. And besides, the chloride, in contact with organic matter, is gradually decomposed, and thus a limited portion of its chlorine is liberated, and unites with the calcareous elements of the tooth.

In the language of Pereira: "The components of the living part, when combined with any of these substances (which form with them insoluble compounds), are less susceptible of decay and decomposition than previously. Hence they are unfitted for the principal property which appertains to their vital condition, viz., that of suffering and effecting transformation." It is on this principle that these remedies exert an antiseptic influence; and it follows that the agent which produces the most permanent insoluble compound with the constituents of the tissue, is the most reliable local antiseptic; while those producing compounds more soluble, and less permanent, often exert a more extended antiseptic influence on large masses of organic matter, simply because they pass into its substance more readily, and to a greater depth. It is well known that the antiseptic influence of tannic acid on the dead skin is perfect, leather being merely tannate of gelatin, while that of arsenious acid, or chloride of mercury, is imperfect. At the same time, by injecting the vessels of the dead subject with either of the latter substances, putrefaction is for a long time prevented, while an injection of tannin could preserve but little, if any, more than the vascular tissues, on account of its inability to pass out of the principal vessels, owing to the nature of the compound it forms with their organic constituents.

Some of the remedies which exert an antiseptic influence act, at the same time, as disinfectants. The chlorides which undergo partial decomposition, when in contact with organic matter, are the most striking examples of this class. The liberated chlorine decomposes the putrefactive agents, and effectually destroys the attendant fetor.



The carious portions remaining in the cavity, therefore, cease, for the time, to be a source of irritation. This, added to the protecting power of the decomposed layer, which is insoluble, explains the fact that when chloride of zinc or terechloride of gold is used on a diseased surface, whether of the soft or bony tissues, the parts beneath the decomposed surface are found healthier than before the application, and more so than when an escharotic of a different class is applied.

By bearing in mind the laws of combination, and the doctrine of chemical equivalents, we might be led to conclude that, when the affinities are equal, the energies of chemical remedies are inversely as their combining proportions; but, that the rule may hold good, not only the affinities, but all the modifying circumstances must be equal. It is certainly true, that if two agents manifest equal affinities for the same constituents of dentine, and the resulting compounds are of the same texture, their *modus operandi* must be the same. In such cases, and only in such, is the activity of the remedies inversely as their equivalents. The equivalent of creasote is 94, that of tannin 212, and the practical activity of the two remedies bears some proportion to these numbers; but if we notice the *modus operandi* of creasote, we will see that its practical energy is much increased by its capability of dissolving fats and other organic substances, thus removing these obstacles to that intimate contact necessary to chemical action. On the other hand, we have seen that but a limited quantity of tannin can be made to act on any surface of organized structure. It follows, therefore, that the practical activity of the one is greater, and that of the other less than is indicated by their equivalents.

It is hoped that the reader already appreciates the fact that there are important differences, both in the modes and in the results of the action of chemical remedies for



inflamed dentine. Due discrimination and accurate judgment are, therefore, necessary in selecting the remedies for any given case. The state of the general system, the physiological structure, and the pathological condition of the tooth must be understood before it is possible to know the treatment indicated. Then, the remedy most likely to fulfill the indication is to be selected, and, without a knowledge of the *modus operandi* of each of those from which the choice is to be made, the selection is, at best, but mere guesswork.

That we may have a clear understanding of this point, let us briefly notice two or three different conditions of the dentine, which may require treatment. Take, for example, a tooth in which the whole body of dentine is inflamed, or at least has exalted sensibility. Now, it is evident that cutting out the sensitive portion is not the plan for this case; for layer after layer may be removed, till the central cavity is reached, and the sensibility may be increased during the entire operation. The patient is therefore tortured to the limit of endurance, while nothing is gained. Nor is the sensibility immediately relieved by the influence of a remedy whose action is limited to the surface; for when the vitality of a superficial layer is thus destroyed, an attempt to remove it demonstrates the fact that the sensibility of the subjacent parts is in no degree diminished, but rather increased. The sensibility in this case, however, may be promptly and totally subdued by an escharotic, which, from its *modus operandi*, is capable of exerting its action on the deep-seated as well as on the superficial parts; and those who wish to resort to this mode, will find arsenious acid all they could desire. This course, however, seems to us much like that of the woman who strangled her bed-ridden husband, by way of helping to ease his misery."

The course we prefer, in such a case, is the application



of an agent which produces an insoluble and permanent compound with the gelatinous portion of the tooth, thus preserving the parts beneath from the influence of irritating agents, till the case has time to terminate in resolution. This protection should be rendered more complete by the insertion of a soft filling into the cavity; and the termination may be much facilitated by constitutional treatment.

In other cases the exalted sensibility may be confined to the surface of the carious cavity. In such, agents which exert a prompt yet superficial action will accomplish all that is desired. The selection will depend somewhat on the circumstances of the case, and will be better understood after the consideration of the individual remedies.

In some cases the inflammation is confined to one or more minute points in the cavity. Then the sharp cutting instrument is often sufficient to overcome the difficulty. When it is not, the treatment suggested for the preceding case may be resorted to.

In considering the individual remedies for inflamed dentine, we do not propose to notice all that have been or that may be used with advantage, but only a number sufficient to accomplish the various actions indicated, and to meet the ordinary demands of practice. We will not attempt a classification; for in the limited number under consideration nothing could be gained by it.

The first that we will notice is

**Tannin, or Tannic Acid.**—Tannic acid is the active principle of vegetable astringents, and is found more abundant in nut-galls than in any other product. It manifests strong affinities. It is soluble in water and alcohol, and slightly so in ether. It unites with albumen, fibrin, and gelatin, forming with them insoluble tannates. It thus enables us to detect gelatin when dissolved in several thousand times its weight of water. Its medi-



cinal action is almost necessarily topical; for the promptness of its action on, and the insolubility of its compounds with albuminous substances, prevent its admission into the general circulation. And this is the sole reason that the vegetable astringents are comparatively mild and innocuous in their action; for a single grain of tannin, if conveyed directly into the blood, would cause instant death.

The action of tannin on dentine has been already explained. Either its watery or alcoholic solution may be used; the latter is the most convenient, in some respects, as the former suffers decomposition by the absorption of oxygen from the atmosphere.

**Creasote, or Carbolic Acid.**—This agent produces its caustic effects by its affinity for albumen and gelatin; and its antiseptic influence arises from the fact that it forms with these substances insoluble compounds.

The creasote of former years was obtained from wood-tar; and in some respects it differs from that in present use, which is prepared from coal-tar. The latter is the genuine carbolic acid. Its medicinal effects are the same as those of the wood-tar creasote, while it is not so unpleasant. It dissolves freely in alcohol and ether, and sparingly in water. Its action may therefore be modified by dilution.

The action of creasote on dentine has been already explained; and, from its *modus operandi*, it is evident that the popular opinion that it promotes the decay of the teeth is an error. Its other uses do not fall within the range of this paper.

**Nitrate of Silver.**—This salt is a powerful caustic, whether applied to the soft parts or to the bony tissues. Its action is somewhat complex. Dr. Turner imputes its escharotic power to the action of the nitric acid which is liberated by the decomposition of the salt in contact with



organic matter. This, however, explains but a part of the process; for the salt seems to have a strong affinity for albumen, and unites with it without undergoing decomposition, in the proportion, according to Lassaigne, of 84·5 of albumen to 15·5 of the salt. This compound is soluble in a solution of nitrate of silver or of chloride of sodium.

When the nitrate is applied to the skin, the immediate result is a whitish mark, caused by the union of the salt with the albumen of the cuticle. This soon becomes black, by the decomposition of the salt and the reduction of the oxyd of silver. It is evident, then, that for each atom of silver set free, an equivalent of nitric acid is liberated. With these facts before us, we will be able to understand its action on dentine.

Let us, then, bear in mind that we have an agent here which acts promptly on the gelatinous portion of the tooth, destroying its vitality to the extent of the combination which takes place; and that by the decomposition of a part of the salt, and the consequent liberation of a part of its acid, it acts also with energy on the calcareous portion.

The compound formed by the nitrate with the organic constituents of the tooth is insoluble, except in a few substances, and therefore protects the subjacent parts, as mentioned in speaking of tannin. The precipitation of the reduced oxyd on the surface affords some additional protection.

The insolubility of the compound above mentioned prevents the absorption of the nitrate by the dentine, and renders its action necessarily superficial. It is not true, then, that its application endangers the pulp, unless the intervening portion of dentine be so thin that it is all required in the chemical union which takes place between it and the remedy; but it is true that its judicious applica-



tion adds to the safety of the pulp, by relieving the inflammation of the dentine, which might otherwise be extended to it.

When the nitrate is neutralized, by an equivalent of the constituents of the dentine uniting with it, no further chemical action can ensue; but it should be borne in mind that the compound formed by its union with the organic portion of the tooth is soluble in a solution of the nitrate. By applying it in too great a quantity, or too frequently, there may be a greater loss of substance than is desirable or at all necessary; for, as long as free nitrate remains in solution in the cavity, the insoluble compound is not precipitated, and the surface is therefore exposed to its continued action. This constitutes a great practical difference between its action and that of tannin; for we have seen that, however much of the latter may be present, but a small quantity of it has the opportunity of producing chemical action.

The compound of the nitrate with the organic constituents of the tooth is soluble also in chloride of sodium; hence, when the fluids of the mouth abound in this salt, the nitrate does not afford that protection to the subjacent dentine which may be obtained by some other escharotics; and in any mouth, the protection is insufficient, if the surface be exposed to contact with food seasoned with the chloride.

In view of the above facts, we prefer to use the nitrate in the solid state; and when this is not practicable, we use a concentrated solution in small quantity, in preference to repeated applications of a dilute one.

In consideration of the caustic energy of the nitrate, as compared with that of arsenic—knowing that the latter is often absorbed and destroys the vitality of the tooth—many fear that the pulp is alike endangered from its use. From the remarks already made, we think it is plain that their



fears are groundless. We will add, however, that all authorities we have been able to consult, agree that it is not absorbed, even when applied to the soft parts, but that its action is *necessarily* confined to the surface. And further, in acute cases of poisoning, by its internal use, there is seldom, perhaps never, any evidence of its absorption.

The subjacent portion of dentine is generally less healthy after the application of the nitrate than after the use of a proper chloride; but, if properly used, the destruction of dentine will be less with the former than with the latter.

With a clear understanding of the *modus operandi* of the nitrate, the practitioner will be at no loss in regard to the cases demanding its use. It acts to a greater depth than tannin or creasote, but not so deep as chloride of zinc, nor does it produce as much pain. Of its action on the soft tissues, we have nothing to say in this paper.

**Chloride of Zinc.**—The chloride of zinc is, perhaps, more frequently applied to dentine than any other caustic. From its *modus operandi*, it exerts an antiseptic and disinfectant as well as escharotic influence. Its principal action is on the animal portion of the dentine; yet, as already seen, a part of it is decomposed, and the liberated chlorine may act on the calcareous salts. As its caustic power depends, in part, on its affinity for water, it is milder in solution than in substance; and its action is, consequently, more superficial and less painful. It is soluble in water, alcohol, ether, and chloroform. The ethereal and chloroformal solutions produce far less pain than the chloride in substance. This might be readily expected—its affinity for water being thus overcome, it exerts but a part of its caustic power. Its union with the gelatinous portion of the tooth is also more prompt when thus dissolved; and this may, in part, explain the diminution of pain arising from its application; as the



ethereal solution of terchloride of gold, which is yet more prompt, causes still less pain. On the same principle, the actual cautery, when very hot, causes less pain and irritation than when of a lower temperature. The ether or chloroform may, however, act directly in lessening the pain by local anæsthesia.

In using the chloride, or any other active caustic, it is important to remember the exalted vitality that follows its use. Practitioners are sometimes disappointed in its action, by either delaying the operation too long or beginning too soon after its application. The former, we apprehend, is the most frequent error. They wait till the exalted vitality commences, but not till it subsides. Now, we regard this as an important point; and it is difficult to lay down definite rules respecting it. It is evident that in the teeth of young persons, and especially in those where the animal matter greatly predominates, the vitality will be more promptly aroused than in those of the opposite texture, and, at the same time, the vital change will be greater. Now, if the exalted sensibility be confined to a thin, superficial layer, it may be almost instantly subdued by the application of the ethereal or chloroformal solution, and the cavity may be excavated before the vitality of the subjacent portion is excited. But if the operation be delayed till the reaction is established, the tooth is often found in a worse condition for excavating than before the application, and a further postponement becomes necessary.

The remarks made on absorption, when speaking of the nitrate of silver, apply with equal force here. There is not the least possible danger from this source—there can be none, even when the chloride is applied to the soft parts.

**Terchloride of Gold.**—Of this substance, we have used only the ethereal solution. It acts with great promptness on dentine, forming an insoluble compound with the ge-



latinous portions; and, by its decomposition, and the consequent liberation of chlorine, it acts also on the calcareous salts. On account of its promptness, neither the pain nor the disturbance of the subjacent parts is great. It is, consequently, very convenient when the exalted sensibility is superficial. The greatest inconvenience connected with its use is its great liability to decomposition. By exposure to air or light, the gold is precipitated in the metallic form. With due care, however, it can be preserved a long time, and it is easily prepared. There is, probably, no danger in its use from absorption; but a more extended series of experiments and observations are required to warrant a positive statement on this point.

**Arsenious Acid.**—The *modus operandi* of arsenious acid is involved in great obscurity. In regard to its topical action, Professor Bache says: "Arsenious acid, when it produces the death of a part, does not act, strictly speaking, as an escharotic. It destroys the vitality of the organized structure, and its decomposition is the consequence. The true escharotic acts chemically, producing the decomposition of the part to which it is applied: a state incompatible with life." Pereira says: "Though employed as a caustic, yet the nature of its chemical influence on the animal tissues is unknown. Hence, it is termed by some a dynamical caustic." Its escharotic power certainly bears no proportion to its destruction of vitality. That it forms definite compounds with some of the constituents of living tissues, is highly probable; yet, if so, they appear to be readily and rapidly decomposed, by which means the acid is again free to effect similar results with the subjacent parts of the tissue.

Nearly all authorities agree that the topical application of arsenic is liable to be followed by constitutional effects. All dentists admit that the tooth pulp may be destroyed by it, through a wall of dentine of considerable thickness.



In general, they maintain that, to accomplish this, the agent must, in some way, penetrate the substance of the dentine. Now, as the dentine is endowed with but feeble vitality, it is evident that its life is destroyed by the agent, to the extent that it penetrates it. Consequently, the vitality of a great portion of the dentine may be lost by the use of the remedy, even when the pulp is not reached. The exalted sensibility of dentine is, then, subdued by this agent, more by its *vital* than by its chemical effects.

The leading argument in favor of the use of arsenic for inflamed dentine is its reliability. Well, it is reliable—and no mistake. Whether the augmented sensibility be confined to a spot, a superficial layer, or extend to the whole body of the dentine, it is alike efficient. It subdues the sensibility in these cases, just as effectually as, when sweetened with syrup, or diluted with water, it overcomes the vitality of rats and cockroaches. The exalted vitality, incident to ordinary escharotic action, is not likely to annoy the operator who uses this remedy; for all such reaction is soon subdued by it. As the despot suppresses the earliest uprisings for liberty beneath his iron heel, so this tyrant drug will not tolerate, in the subjacent dentine, even the slightest attempt at rebellion.

The most soluble preparations of arsenic are the most energetic; and the quickness with which it acts is in proportion to the absorbing powers of the part. It is sometimes extensively used as a topical application, without inducing constitutional effects; and, in other cases, the constitutional symptoms are alarming, from the local use of a very minute quantity. The whole weight of authority, we think, demonstrates the fact that the pulp is never safe when it is applied to a carious cavity of a tooth; and, as inflamed dentine may be otherwise relieved, that it should never be applied to a tooth, unless the extirpation of the pulp is indicated.



## COLD APPLICATIONS TO ACHING TEETH.

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ÆSOP tells us of a Satyr who kicked a traveler out of his cavern, where he had been kindly entertaining him, because he blew his breath on his fingers to warm them and on his victuals to cool them. Blowing hot and cold with the same breath being a mystery he could not fathom, he regarded it as an inconsistency he would not tolerate within his premises. But the traveler was right in his head, and true to the laws of caloric, nevertheless. The Satyr had, simply, failed to study the philosophy of heat. Many mistakes like that of the Satyr occur in our profession.

Almost every one knows that cold applications sometimes relieve the pain of toothache, and sometimes aggravate it. I once heard an aged and experienced member of our profession say that "this is the greatest mystery of our specialty." The Satyr had neglected the laws of heat; our professional father had not mastered the principles of pathology.

When there is an increase in the quantity of blood in any part or tissue of the body, with increased motion of it through the vessels of the part, the phrase, *determination of blood*, is used to express the condition. In the act of blushing, there is determination of blood to the cheeks. When there is increased quantity of blood in a part, with diminished motion, the condition is called



*congestion.* When there is increased quantity of blood in a part, with increased motion in some of its vessels, and diminished or obstructed motion in the others, the condition is *inflammation*.

Pain may be experienced in the dental pulp or periosteum from any one of the above conditions. Any one of them will produce pressure on the sensitive nerve fibrils, the degree of pressure varying directly with the degree of departure from the normal condition, and the resistance of the surrounding parts. The pulp and the dental periosteum being incased in, or between bony textures, are far more painful, under the same degree of congestion or inflammation, than are similar tissues surrounded by muscle or membrane. *They have not room to swell.*

Cold applications to living tissue cause a contraction of its vessels. If the pain, resulting from pressure on the nerve fibrils, is caused simply by determination of blood, the contraction of the vessels forces out the excess of their contents, and the pressure is relieved, and, of course, the pain ceases. The same result follows the application when congestion is present, though less promptly. But when inflammation is the predominant pathological condition, the motion of the blood through the vessels is obstructed—in some of them arrested, even; hence, the vessels are not able to force out their contents by contraction, and so contract on them, thus increasing instead of diminishing the pressure, and, therefore, aggravating instead of alleviating the pain.

With these views clearly before the mind, any one can appreciate the reasons why cold applications sometimes alleviate, and at other times aggravate the pain of toothache. And the feelings of the patient afford a guide to the treatment. While relieved by cold, the pathological



state is not one of inflammation ; and thus we are afforded a guide in diagnosis. Determination of blood and congestion may be overcome by a persevering use of cold ; while in inflammation a treatment directly opposite is often indicated. Without trying to be technical, I hope I am understood.



## INTRA-STOMATIC GALVANISM.

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An Inaugural Dissertation submitted to the Trustees and Faculty of the Ohio College of Dental Surgery, for the Degree of Doctor of Dental Surgery, February 10, 1854.

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WHEN two solid conductors of electricity are plunged into a liquid which acts upon them unequally, the electric equilibrium is disturbed; the one acquiring the positive, the other the negative condition. Zinc and platinum put into dilute sulphuric acid constitute such an arrangement, and electric force is thus generated.

With these facts, and with galvanic action in general, the profession are familiar, but many seem to be unaware of their importance in dental surgery.

We do not propose to notice the science of galvanism in general, but will confine our remarks principally to its actions and influence within the mouth. But, to arrive at a proper understanding of these, it is necessary to observe some of the elementary facts and leading principles of the science.

The essential elements of a galvanic battery are one imperfect and two perfect conductors, or one perfect and two imperfect conductors. The metals, charcoal and moist animal substances, though differing in conducting power, are called perfect, while water and aqueous solutions are called imperfect conductors. In the battery first described, it is essential that the imperfect act chemically on one of the perfect conductors.



The voltaic current is the great instrument of chemical decomposition, especially of binary compounds. Galvanic decomposition is called *electrolysis*; a substance which may be thus decomposed is an *electrolyte*, and the terminations of the battery are called *electrodes*.

One of the indispensable conditions of electrolysis is fluidity. Bodies which, when liquid, conduct freely, and as freely suffer decomposition, are absolute insulators to voltaic electricity in the solid state. All liquids, however, are not electrolytes. Many refuse to conduct, and consequently no decomposition can occur.

It becomes necessary here to distinguish carefully between primary and secondary decomposition, that is, between true electrolysis and that decomposition brought about by the reaction of the substances eliminated upon the surrounding fluid, or upon the electrodes. These secondary actions are very numerous, the disunited elements being presented in their nascent form, which is peculiarly favorable to chemical action.

The voltaic decomposition of most acids and salts is to be attributed to these secondary actions.

Electrolytic decomposition depends on the quantity of the electric fluid passing through the electrolyte, but the secondary actions depend on the nature and quantity of the agents evolved by the former. Thus hydrochloric acid has no effect on gold; but when, by electrolysis, its chlorine is evolved against a gold electrode, chloride of gold is formed.

By means of the magnetic galvanometer, it has been demonstrated that the quantity of electricity traversing an acid solution of uniform strength, varies inversely as the square root of the distance between the plates—the distance varying from 4 to 1, the current will be as 1 to 2. Thus it will be seen that very small exciting surfaces may produce vigorous chemical action, when the distance be-



tween them is but trifling. Accordingly, the late Professor Fownes remarks: "A pair of small wires of zinc and platinum, dipping into a single drop of dilute acid, develops far more electricity, to judge from the chemical effects of such an arrangement, than very many turns of a large plate electrical machine in high action, yet electrolytic decomposition can be distinctly and satisfactorily effected by the latter."

In comparing the effects of electric currents, the late Dr. Turner remarks: "Feeble agencies, operative for a long period, are often just as efficacious in effecting great changes as powerful agents at work during a short period."

Bearing the above principles in mind, let us apply them practically to the mouth.

We do not propose to go into the analysis of the fluids of the mouth, nor of the foreign substances introduced into it, as this would require space beyond our present limits. Suffice it to say that the saliva has a strong affinity for oxygen, and absorbs it readily from the atmosphere; that it corrodes many of the metals; that it is an electrolyte; and that acidity is generally a result of its decomposition.

Let us now notice some conditions of the mouth artificially produced. It is universally admitted that a tooth surrounded by a clasp is apt to decay, and a variety of reasons are offered to explain this tendency. It is evident that it is often, if not always, promoted by galvanic action. A portion of food, a piece of animal fibre, for instance, lodges between the tooth and clasp, a perfect battery of the first kind is thus formed, the saliva being the imperfect, and the clasp and fibre the perfect conductors. The other requisite condition is also present, for the saliva acts chemically on the fibre. This being the case, the binary compounds of the saliva are electrolyzed. Water being



one of them, of course its oxygen goes to the positive side, combines with the nitrogen of the fibre, and nitric acid is produced, which dissolves the enamel as fast as formed. The enamel being removed, the animal portion of the tooth forms a part of the battery, and the current continues without the lodgment of a foreign substance.

It is evident that the tooth, being a solid substance, is not electrolyzed, but that its carious condition is a result of secondary decomposition. We have shown that it may take place from the electrolysis of the water of the saliva. It may also take place from the decomposition of the chloride of sodium; the chlorine being evolved at the tooth, will displace the phosphoric acid, and take up the lime of the enamel.\* It may take place from the electrolysis of almost any of the binary principles of the fluids of the mouth, or of all of them, as they will be decomposed in the ratio of their equivalents.

Galvanic action is often produced in the mouth by the use of metals or alloys which are easily oxydized, and more especially when two or more are used which differ in their affinity for oxygen. This often results from the use of solder of a low carat, or from silver solder used on gold plate. It *always* takes place when any of the "thousand and one" amalgams are used for filling teeth. Minute circles, similar to those on the surface of excited commercial zinc, are always produced by the action of the saliva on these fillings. The greater the number of metals used, the more energetic will these circles be, and if their affinity for oxygen differs greatly, the most oxydizable will, of course, corrode more rapidly on account of the currents thus established. When the oxydation progresses till but one metal remains, the porosity of the filling pre-

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\* The liberated chlorine unites with the hydrogen of the water present, forming hydrochloric acid, which acts on the tooth.—  
AUTHOR.



sents a condition peculiarly favorable to secondary decomposition, which, as in the former case, causes the destruction of the tooth.

The minute currents established by these compound fillings decompose the binary compounds of the saliva, just as those of excited commercial zinc decompose the water of the exciting solution. To understand one obvious effect of secondary action in these cases, we have only to reflect that the chlorine of the chloride of sodium, and the hydrogen of the water, are set free, unite and form hydrochloric acid, and that all this takes place in contact with the tooth. When proximal cavities are filled with these "compounds," the adjacent teeth are often thus destroyed.

When the adjoining tooth is filled with gold, we have a most powerful battery of the first kind. We have often seen an amalgam filling which had remained in the mouth without serious results, produce all its deleterious effects, on the introduction of a gold filling into a neighboring tooth. Since we began writing this, we saw a case which illustrates our position: in a cavity on the labial surface of the second lower molar was a gold filling, and an amalgam plug occupied the corresponding position in the dens sapientiæ. We will be minute here, for we wish to be understood. Let the gold represent the copper, and the amalgam the zinc of the ordinary apparatus. Both being, as it were, in the exciting cell, the gold is negative, and the amalgam positive. Now, in their electrolytic action, all the binary compounds of the saliva, as already remarked, are decomposed, and the electro-negative elements, of course, go to the amalgam filling. Of water, the oxygen, and of chloride of sodium, the chlorine appear there, and, being in their nascent state, unite and form chloric acid.\* Nothing but the destruction of the tooth

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\* Hydrochloric, and not chloric acid is formed in such cases.—  
AUTHOR.



containing the amalgam could be expected under such circumstances; and it was, accordingly, found in a softened condition.

It will be observed that we have said nothing concerning the deleterious effects of these amalgams on the general constitution. Nothing is needed, for "TEKEL" is stamped upon them. We have intentionally confined our remarks to their influence on the teeth alone. In speaking of their constitutional effects, Professor Piggot justly remarks: "The amalgam question, as it has been called, is thus answered with the utmost promptitude by chemistry. To the chemist it has but one side; it needs but to be stated to be immediately decided upon." We will merely add, in this connection, that chemistry not only answers "with the utmost promptitude," but from all its departments gives the same answer, the severest *tortures* failing to elicit any other.

To notice all the sources and results of galvanic action within the mouth, will lead us beyond our present limits. We have spoken of the more frequent causes, and the most obvious effects of these currents. We have throughout supposed the fluids of the mouth to be natural and healthy. If we have demonstrated, by way of illustration, that three of the strongest acids known to chemistry are, in their nascent state, brought in contact with the teeth, we have at least partially succeeded in our undertaking.



## ALVEOLAR HEMORRHAGE.

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THOUGH in ordinary cases the extraction of a tooth is followed by but a slight flow of blood, yet few practitioners have failed to witness cases in which the hemorrhage was quite annoying, if not dangerous.

Alveolar hemorrhage may be considered as *accidental* or *constitutional*. Without feeling under obligation to defend the propriety of the use of these terms, we will state that, when the hemorrhage is the result of an undue laceration or incision of the gum and its vessels, we call it accidental—when it results from a morbid state of the blood, or from a peculiar state of the constitution (called the hemorrhagic diathesis), we consider it constitutional.

In the treatment of accidental hemorrhage, the appropriate use of styptics and pressure will accomplish all that is desired. Nature's process for arresting hemorrhage is, to close the bleeding vessels by coagulating the fibrin of the blood—by forming a *clot* in or around the mouth of the vessel. The clot thus formed is in many cases not firm enough to resist the pressure of the blood, and hence the bleeding continues. Art steps in to assist, and, by *pressure*, retains the clot in its place, when in most cases it effectually plugs up the vessel. In a good constitution, except where a large vessel is divided, this combination of the powers of art and nature is able to arrest the bleeding. But when the divided vessel is large, the pressure of the blood breaks down (or tears up) the clot, and other means are necessary. And if the blood be abnormal, the clot, if formed at all, may be of so soft a texture that it will avail



nothing, even when pressure is appropriately applied to support it.

The object in using styptics is to obtain a firmer clot than is produced by the spontaneous coagulation of the blood. All styptics act chemically. To exert a styptic influence, an agent must have an affinity for some component of the blood; and the compound formed by virtue of this affinity must be, to some extent, insoluble. The albumen and fibrin are the principal constituents of the blood concerned in the combination with styptic agents. Many substances which manifest a strong affinity for these components have no styptic influence. For example, the caustic alkalies combine energetically with them, but form liquid compounds, and, therefore, present no obstruction to the flow of blood.

It is important, then, in deciding the choice of styptic agents, to notice carefully the characteristics of the compounds formed, respectively, by their union with albumen and fibrin. To be better understood, let us suppose a set of experiments with tannin, nitrate of silver, and albumen. The nitrate combines energetically with the albumen, forming a firm coagulum or clot; but this coagulum softens and dissolves in albumen. Hence, if more albumen be present than is sufficient to combine with and neutralize the nitrate, the clot cannot remain solid and firm.

If, then, the nitrate be applied to a bleeding vessel, a coagulum is formed in its mouth; but the blood in the vessel (containing fresh albumen) gradually dissolves its way through it. The arrest of hemorrhage by this agent is, therefore, but temporary. We are thus minute because many infer that, as the nitrate is a powerful escharotic, it is also a most reliable styptic.

On the other hand, if tannin (tannic acid) be applied, the coagulum will be less extensive, but more firm, while it is not soluble in albumen or any other ingredient of the



blood. Consequently the blood cannot *dissolve* its way through it, as in the former case; and, if it be judiciously supported by pressure, so that the blood cannot *break* through it, the result is an arrest of the bleeding.

Sulphate of copper, sulphate of zinc, acetate of lead, and kindred mineral astringents, also form compounds with albumen and fibrin which are soluble in an excess of albumen, and consequently in fresh blood. Their styptic power is, therefore, but transient.

In February, 1858, Professor C. had an upper molar extracted about 10 o'clock in the morning. The hemorrhage was slight at the time; but about 12 M. it became excessive. He applied, successively, several of the mineral astringents, with but temporary success. At 8 P.M. I visited him, and found his attendants, by his direction, using the sulphate of copper and pressure, without any diminution of the flow of blood. I removed the application, washed out the mouth, applied a solution of tannin on a pledget of cotton, and confined it by pressure. The bleeding ceased immediately, and did not return. A number of similar cases might be reported, but this must suffice, as our present object is *illustration* not *confirmation*.

The sesquichloride of iron is a more reliable styptic than tannin. It combines promptly with the albumen and fibrin of the blood as well as with the coats of the vessel; and the compound it forms with them is all that we can expect. In urgent cases we much prefer it to tannin.

The actual cautery (a hot iron) is not a desirable remedial agent in alveolar hemorrhage, nor is it as efficient as other means in our power.

In making pressure for the arrest of alveolar hemorrhage some judgment is required. Filling the socket will not always answer the purpose. The margins of the



gums escape the pressure when it is applied, and may continue to bleed. It should, therefore, be applied so as to bring them toward each other. This is readily accomplished by cutting a piece of cork in the shape of a block letter V, and setting it astride the gum, after applying to it a fold of cotton, wool, or other soft substance. The closure of the mouth on the cork gives the required pressure; and the mouth should be kept closed by a bandage.

When the hemorrhage arises from constitutional causes the constitution should be treated; and, when it is known that the patient is of a hemorrhagic diathesis, the treatment should generally precede the operation. If the bowels are constipated, a saline cathartic will be advantageous, after which opium and acetate of lead should, generally, constitute the main reliance.

General principles must govern the practitioner in the use of these remedies. Of course, different cases will require different treatment.

If there be no opportunity to treat the constitution before the operation, it should be promptly treated afterward; and at the same time local treatment should be diligently used. The intelligent operator will seldom have much difficulty if he has an opportunity to treat the case promptly.



## NITRATE OF SILVER.

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It is strange that men of thought and men of education should so persistently misunderstand the action of this salt on organic tissues. By some means it has been long ranked as the chief styptic, both by physicians and dentists; and having gained this rank, its title-deed to the same has been but occasionally disputed.

I have been often exceedingly annoyed, when reading on the subject of hemorrhage, to find the author, after enumerating alum, tannin, and other styptics, add, "if these fail, apply *lunar caustic*." Even our friend, Prof. Richardson, in his article on leeches, follows in the same strain. He says: "If from any cause the hemorrhage should be excessive it may be arrested by making firm pressure over the incision with a little lint; this failing, apply a piece of lint moistened with solution of alum or other convenient styptic; or touch the part with lunar caustic. If the bleeding is urgent, and not easily controlled, a solution of the persulphate of iron may be used." (*Dental Cosmos*, Nov.) Now, why mention lunar caustic (nitrate of silver) at all in this connection? Possibly because Pereira and others have done so before; but certainly not because it is reliable or useful as a styptic. It is a very active *caustic*, and its application causes pain. Would it not, then, be better to direct the persulphate at once, as it is a *styptic*, and its application produces less pain and irritation?

Many salts form combinations with the protein compounds of the blood. Nitrate of silver is one of them.



It combines directly with albumen and fibrin, forming a semi-solid compound, often called a coagulum. Now, if this coagulum were permanent, the nitrate might be regarded as a styptic; and if it were, at the same time, firm in its texture, we could rely on this salt as a good styptic. But while it is not firm, it is soluble in an excess of either of its ingredients. The consequence is that when this salt is applied to arrest hemorrhage, a soft coagulum is formed, which may and often does arrest the flow for a time; but if the hemorrhage is active or obstinate, the albumen of the blood dissolves its way through it, and nothing permanent is gained.

A genuine styptic forms, with some part of the blood, a compound, firm in its texture, and not soluble in fresh blood. And nothing is plainer than that the nitrate fails to fulfill these conditions. It was introduced among the class of styptics before its action on living tissues was well understood; and that so many still class it thus, only shows how little original thought there is in the world.

Tannin, perchloride, and persulphate of iron are the most reliable styptic agents; and the application of any of them is less unpleasant than that of the nitrate. There is, therefore, no excuse for the use of *lunar caustic* in such cases. It should be left with the escharotics, where it naturally belongs.

Tannin forms a firmer compound with albuminous tissues than any other known substance; but the layer of coagulum is so thin that it is liable to be broken through by the mere force of the current. Were it not for this, it would be a far more reliable styptic than either of those mentioned in connection with it.

Many, no doubt, are ready to say that they have applied the nitrate with success. So has the sorceress applied her charms with success. The blood has ceased to flow, but "*post hoc non ergo propter hoc.*" This reminds us of a



case in point: A few years ago I was called to see an eminent physician, who had been bleeding some ten hours after the extraction of an upper molar. By direction of himself, and perhaps other medical friends, nitrate of silver, acetate of lead, sulphate of zinc, and finally sulphate of copper, were perseveringly applied, accompanied with pressure, and other means. The hemorrhage was not arrested, except for a few minutes after each application, and was rapidly on the increase at the time of our visit. By removing the clots, and applying a solution of tannin, with moderate pressure, the flow was instantly checked, and did not return. The patient was astonished, and inquired why that application succeeded when more powerful styptics had failed. We replied that, in a chemical point of view, he had not used *styptics* at all—simply astringents and escharotics, and that the application of the tannic acid was successful because tannate of albumen is insoluble in blood. “Every man to his department,” was the modest reply of my patient, the now lamented Professor Cobb.



## ARSENIC AND ITS COMPOUNDS.

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As a metal arsenic, sometimes called *arsenicum*, is unimportant. Were it not that, by union with other elements, it forms important compounds, it would claim attention only as a curiosity in science.

The metal is readily obtained by decomposing arsenious acid, which is the well-known white arsenic or “rat’s bane” of commerce. The method suggested by Turner is convenient for the dentist: mix a portion of white arsenic (arsenious acid) with two or three times its weight of powdered charcoal; put the mixture in a large Hessian crucible; invert a smaller one over it, and lute the two together. Heat the one containing the mixture to a red heat, while the other is kept comparatively cool. The metal sublimes, and is deposited on the inner surface of the upper crucible.

Arsenic is frequently found in combination with other metals, especially with iron, cobalt, and zinc. It is a brittle, whitish-gray, crystalline metal, having a strong metallic lustre, and sublimes without liquefying, its vapor having the odor of garlic. It may be vaporized in close vessels without undergoing change; but when exposed to the atmosphere it combines with oxygen.

With oxygen this metal forms three compounds—a grayish *suboxyd*, *arsenious acid*, and *arsenic acid*. The composition of the first is not satisfactorily determined. It is supposed by some to be a mixture of arsenious acid with metallic arsenic. Arsenious acid is composed of one equivalent of arsenic united with three of oxygen. Its



formula is, therefore,  $\text{AsO}_3$ , the degree of oxydation corresponding with that of sulphuric acid. Arsenic acid consists of one equivalent of arsenic combined with five of oxygen, its formula,  $\text{AsO}_5$ , corresponding with that of nitric acid. The equivalent of the metal being 75, and that of oxygen 8, it is easy to calculate the relative quantities of the two elements in any given quantity of either compound.

**Arsenious Acid.**—It is stated above that, when sublimed in contact with atmospheric air, arsenic unites with oxygen. Arsenious acid is the compound usually formed. It seems to be the favorite combination of the two elements, and is, therefore, much more familiarly known than the others. Being so much more common than the other compounds, or than the metal uncombined, it is usually called simply “arsenic.”

This acid may be melted by heating it in a tube closed at both ends. By fusion it becomes a colorless liquid. When left free it volatilizes at about  $400^\circ$ , without melting, producing a colorless and inodorous vapor. Whenever the “garlic odor” is perceived, it is evident that the acid is, in part at least, reduced, and that metallic arsenic is volatilized.

As commonly seen, arsenious acid is a fine white powder; but, in its solid state, it is found in three distinct modifications, one of them amorphous, and the others crystalline. When its vapor is condensed, at a temperature near its melting point, the acid is converted into a transparent, vitreous mass. When sublimed slowly, and the vapor is condensed at a lower temperature, the acid crystallizes in regular octahedrons. And crystals of the same form are obtained when the acid separates from an aqueous or ammoniacal solution. The acid is sometimes found in the form of thin, flexible, transparent plates, supposed to be derived from the right rhombic prism. The octahedral



seems to be the favorite form with this acid, as the vitreous gradually passes into this modification, and the rhombic changes to it when volatilized.

The specific gravity of arsenious acid in its octahedral form is about 3.70, in its vitreous 3.74. The vitreous is more soluble in water than the opaque, crystalline acid, though the observations of some experimenters lead to a different conclusion. According to Klaproth and others, 1000 parts of water, at  $60^{\circ}$ , dissolve only two and a half parts of the powdered acid, while the same quantity of boiling water dissolves 77.75 parts, 30 of which it still retains when cooled to  $60^{\circ}$ .

The watery solution of arsenious acid is transparent, colorless, inodorous, nearly tasteless, and reddens litmus slightly.

This substance evinces its acid nature by forming definite salts with basic oxyds. One equivalent of the acid unites with two of lime, forming a subarsenite of lime, as represented in the formula,  $2\text{CaO}, \text{AsO}_3$ . With potash and soda it forms similar subarsenites, and also neutral arsenites, and hydrated binarsenites, the latter being represented by the formula,  $\text{KO}, \text{AsO}_3$ , and  $\text{KO}, \text{HO}, 2\text{AsO}_3$ .

Arsenious acid is more soluble in many acids than in water. From its solution in boiling hydrochloric acid, it crystallizes unchanged, the formation of the crystals being accompanied with the liberation of light.

The arsenites are all easily decomposed, and are all poisonous.

**Arsenic Acid.**—By the action of nitric acid, or *aqua regia*, arsenious acid is transformed into *arsenic acid*. This acid is readily obtained by dissolving arsenious acid in concentrated nitric acid and applying heat. The action is more prompt when a little hydrochloric acid is added. The mixture is then to be evaporated to dryness, to get rid of the excess of nitric and hydrochloric acids. Too



high a temperature is to be guarded against, as at a red heat, or probably lower, the acid is decomposed, resulting in arsenious acid and oxygen. The action of nitric on arsenious acid is represented by the formula,  $6\text{AsO}_3 + 4\text{NO}_5 = 6\text{AsO}_5 + 4\text{NO}_2$ . The binoxyd of nitrogen,  $\text{NO}_2$ , escapes as a gas, and, as soon as it reaches the atmosphere, is changed to nitrous acid,  $\text{NO}_4$ , by taking oxygen from the air. The nitrous acid fumes are red or orange colored, and if an excess of nitric acid is used in the process the cessation of these fumes indicates that all the arsenious acid in the mixture has undergone the desired change.

Arsenic acid, thus prepared, is a white, granular substance, has a sour, metallic taste, reddens litmus, is soluble in five or six times its weight of cold water, deliquesces slowly in the air, and from its solution thus formed, deposits hydrated crystals. With basic oxyds it forms definite salts, usually called *arseniates*, but correctly, *arsenates*.

**Arsenide of Hydrogen.**—When metallic arsenic is made the negative pole of a battery in the galvanic decomposition of water, a solid compound of arsenic and hydrogen is formed, which possesses but little practical importance. But there is a gaseous compound of the same elements which is called *arseniuretted hydrogen*, and which is worthy of attention. It is formed by the union of three equivalents of hydrogen with one of arsenic.

This gas may be obtained by various processes, but the most convenient is to dissolve zinc in dilute sulphuric acid in which arsenious acid is mixed. The reactions are represented as follows:



It is well known that when zinc is dissolved in dilute sulphuric acid, hydrogen is liberated. In its nascent state



this element is able to take arsenic from any of its known combinations, and great reliance is placed on this fact in testing for arsenic, as will be noticed in due time.

Other compounds of arsenic are interesting, but are not of sufficient practical importance to claim special attention here. In a future number this subject will be continued.



## EXPOSED PULPS—SECONDARY DENTINE.

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THERE is some diversity of sentiment among dentists on the subject of exposed pulps. This is refreshingly evident from the reports of discussions at the late meeting of the American Convention. Diversity of opinion, on an important subject which is but partially understood, is an evidence that progress is about to be made toward its thorough investigation. Some points in regard to this subject appear to be already settled. All agree that a living, healthy pulp is important to the well-being of the tooth. All admit that exposure of the pulp is a misfortune. Every dentist endeavors to avoid its unnecessary exposure. But when this misfortune has happened—when the pulp is exposed, what is to be done? That is the question.

Many prominent dentists—a majority, perhaps—advocate the extirpation of the pulp in all cases of exposure. The slightest exposure of the pulp of the most important tooth of the healthiest patient meets with no mercy at their hands. The pulp is exposed. That is sufficient. It must be destroyed. If the profession is to be restricted to but one mode of practice, in the treatment of exposed pulps, that of extirpation is, doubtless, the one to be adopted. There are some, however, who claim that, in many cases, there is “a more excellent way.”

While they treat, by extirpation, a large majority of the cases of exposed pulps presented to them, there are some who maintain that we should discriminate in regard to the character of the cases referred to us. They believe that a



slight exposure of a healthy pulp in a good constitution does not call for extirpation. They claim that the pulp, under such circumstances, may be preserved by proper treatment, and that, consequently, the tooth will be much more likely to be permanently useful than if it were destroyed.

This is a very important question. There is none before the profession more so. In its investigation all prejudices should be laid aside. No one can afford to be in error here. If some teeth can be saved alive throughout their entire structure, after their pulps are exposed, it is important to know what ones. If none such can be saved, it is as important to know it; for those who try to save them merely torture their patients, and bring reproach on their profession.

Let us, then, inquire what is the exact condition of a pulp that is merely exposed, but not diseased. And by the term pulp, here, without aiming to be technical, we include all the soft tissues found in the interior of a normal tooth.

The pulp is a highly organized soft tissue. It is well supplied with both vessels and nerves; and the diameter of the former is sufficient to admit the red globules, and, consequently, all the constituents of the blood. It has the ordinary physiological properties and functions of other soft tissues, and is, therefore, liable to all the ordinary pathological changes of such tissues. It may be wounded, and the wound may heal. It is liable to inflammation, which may terminate in resolution, suppuration, ulceration, or mortification. Like other soft tissues, it admits of contact with some foreign bodies, without being pained. And like them, it may tolerate such contact for some time without taking on inflammation, or even irritation. It is covered by or invested with the lining membrane of the pulp cavity, and has a vital connection with it. This



membrane bears the same relation to dentine that the periosteum does to ordinary bone, and performs corresponding functions. It is the medium of connection between the soft parts of the system and the dentine. It supplies ossific matter to the dentine as the periosteum does to bone. By the normal fulfillment of its function, the pulp cavity is lessened as age advances; and, by an increase or quickening of this function, the pulp is often protected from exposure by the wearing away of the teeth, or by caries. Both the physical and chemical properties of dentine vary with the condition of this membrane while depositing it. When there is nothing to disturb its functions, ordinary dentine is deposited by it. When its vital energies are aroused, "secondary," or rather modified dentine is formed; and when its vital force is depressed, or there is a lack of ossific matter in the blood, this modified dentine is often porous and irregular, and sometimes closely resembles cementum.

Now, it is a well recognized fact that the periosteum will deposit bone, even when deprived of its ordinary connection with bony structures. All that is necessary is for it to have a vital union with the general circulation. When stripped from the bone, and transplanted, it still performs its normal functions. A bone may be lost by necrosis, but, if the periosteum remain, a new bone will be formed, resembling the lost one in shape in proportion as the integrity of the periosteum has been preserved.

Bearing these principles in mind, we will endeavor to apply them shortly.

The propriety or impropriety of ever attempting to preserve an exposed pulp is to be determined by a careful consideration of two questions: 1. Is there any substance, which can be permanently retained in the tooth cavity, which the pulp will tolerate as a substitute for its wall of dentine? 2. Is the pulp (the lining membrane being in-



cluded) capable of depositing dentine or other bony tissue for its own protection? Each of these questions must be answered by observation and experience. Theory can and does give much light on the subject; but it must be verified by experience before we can rely implicitly on it.

In answer to the first question, it may be stated that there are well authenticated cases in which the pulps have retained their vitality for months, and even for years, though in contact with a foreign body introduced in filling the teeth. But even if this question is answered in the negative, let us examine the second. All, I believe, admit that the pulp is the organ which deposits the bony matter of the tooth. Now, when the pulp is exposed, does it lose all ability to perform its functions? It yet retains its vitality, and is often found perfectly healthy. Or is it merely the point exposed that has lost its function? Why should it lose it while it is still alive and healthy? True, it is no longer connected with the dentine; but we have seen that the periosteum will deposit bone when transplanted to soft tissue. The membrane at the point of exposure still retains its vital connection with the general circulation. It receives ossific matter just as it did before exposure. Is there any physiological reason why it should not deposit it, just as the periosteum does, if it be thoroughly protected from external or foreign irritating agents? Or, if the part exposed does lose its function by exposure, is there any reason why the parts around the border of the orifice cannot throw out osseous matter, and thus close the orifice? The periosteum can unite fractures without exact apposition of the fractured parts. Recollect that the question refers only to cases of slight exposure. And when the exposure is slight, and the pulp and membrane are healthy, and the decayed matter is all removed, and irritating agents are carefully excluded, wherein does the case differ from that of a compound



fracture? The circulation of the pulp is the same as that of the soft parts around a fracture, with this advantage, that its vessels are entire, while some of those concerned in the other case are ruptured. No one is surprised when a compound fracture heals by osseous union, for the simple reason that it is a common occurrence. When a fracture occurs, the parts are adjusted, and the patient is nursed, that it may heal. This has been the practice from time immemorial. But when the pulp is exposed, the tooth is extracted, or the pulp is destroyed or left to die. From time immemorial no one has cared for it. Hence comparatively few cases of recovery by osseous protection have been observed.

This brings us exactly to the turning point of the whole question. Have any cases been observed in which the pulp has protected itself, after exposure, by a deposit of dentine or other bony tissue? And here we will be allowed to refer to names. And, in doing so, we only aim at the attainment of truth. And we have just as much respect for those with whom we differ in opinion as for those with whom we agree. We will not attempt to give the views of many members of the profession; and as the discussions on the subject of exposed pulp, at the Saratoga meeting, are still fresh in the minds of our readers, we will notice, a little, the views expressed there.

Dr. Taft, the first speaker on the subject, in favorable cases, fills temporarily, over exposed pulps, and claims that, in many cases, they are eventually covered by a bony deposit.

Dr. Atkinson sets up the same claim, and proposes to show cases of secondary dentine.

Dr. Dwinelle alluded to "specimens in his possession where large portions of secondary dentine had been deposited." He also "gave a case where the nerve bled, was filled, and, on being opened, a secondary formation



of dentine was found " He states, further, that he had "filled many cases, and examined them, and found secondary dentine." He "had examined such cases microscopically, and had specimens." He had "practiced filling such cases for years with the greatest success."

Dr. Morgan "has often found secondary dentine in cases where a tooth has been filled over exposed pulps."

Many other members of the profession, that we might name, advocate the same practice, and claim like success. None of them maintain that it would do to treat all, or even a majority of exposed pulps this way. But they do maintain that if some teeth can be thus saved, it is worth while to make the effort. And they hope that still further light will be gained, so that it will be easier to distinguish those which can be saved from those which cannot.

On the other hand, we are told that Dr. Westcott has "met with no success" in this treatment for exposed pulp. How extensively and carefully he has tried it we are not told; but, in the absence of information, we are to presume that he has given it a fair investigation.

Dr. Wetherbee "doubted the practicability of saving exposed nerves." He has "never seen a case of secondary dentine formed to protect a nerve."

"Dr. Rogers had never known of a case, where the pulp was wounded, to be restored by the use of caps, or any other method." He thinks "nine-tenths of the pulps treated with a view to save their vitality, even by the best operators, fail."

Others, on both sides of the question, might be referred to, but these must suffice, as this article is already too long.

To the candid reader, a few questions would naturally present themselves at this point. Are those who advocate the preservative treatment of exposed pulps competent to judge accurately in regard to the success or failure



of their treatment? If they are not, is it because their ability to observe is defective, or because the subject is a difficult one? It cannot be the latter, for it is easy to see an exposed pulp in some cavities; and when it is wounded the hemorrhage clearly reveals the fact of exposure. Nor is it difficult, after removing a temporary filling, to ascertain whether or not the pulp cavity is closed. New deposits of dentine, if any exist, are easily recognized. And if the pulp is dead, the odor, as referred to by Dr. Rogers, will generally reveal the fact.

We conclude, then, that those who advocate the preservative treatment are as competent to observe facts as those who recommend extirpation. They can see as well, and their sense of smell is just as acute. They can probably detect a failure as readily as their brethren, and they have just as little interest in practicing erroneously. They are not at all superior to their brethren, however. But let us look at the testimony given. One party testifies, individually, that they think it reasonable that the pulp, in favorable cases, should be protected by a new deposition of bony tissue, and that they have seen many cases in which it has been thus protected. The others tell us that they think it unreasonable, and that they have never seen a case in which it has occurred. Shall our verdict be in accordance with that of his Honor the Mayor, who fined Patrick because two witnesses said they saw him strike Tim, while a dozen said they didn't see him do it?



## BLEACHING.

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WE are glad to see that the subject of bleaching teeth occupied, to a good extent, the attention of the late Convention at New Haven. It is an important and intricate subject; and that it is beginning to elicit the attention of the profession is evidence of progress. We are aware that individuals have given the matter some care; but, as a profession, we certainly do not understand the subject.

In looking at this subject, the first inquiry ought to be the chemical characteristics of the coloring materials that are to be decomposed. Without, at least, some general knowledge in this direction, all our efforts will be empirical. Now, it may be sufficient for our present purpose to state that most if not all of the coloring matters which concern the dentist are organic compounds. Most of them contain carbon, hydrogen, oxygen, and nitrogen. And it is scarcely necessary to remark that their color is dependent on their composition. If one of their elements be removed, or if their proportion be much varied, the color will be changed or obliterated.

The object to be aimed at in bleaching, then, is to decompose the coloring compound, by some agent or agents for which one or more of its elements have a strong affinity. Of course the agent of decomposition must have an affinity for at least one element of the coloring compound, stronger than that by which it is held in the compound.

Bearing these things in mind, we can understand the action of some of the best known bleaching agents.

Sulphurous acid, which is always formed when sulphur



is burned, and is commonly called sulphur smoke, has a powerful affinity for oxygen, and usually bleaches by taking that element from the coloring compound. This acid is extensively used by bleachers of straw millinery.

Chlorine, which has been termed "the great bleaching agent," as is well known, has a strong affinity for hydrogen, and sometimes bleaches by taking this element from the coloring compound, and sometimes by taking hydrogen from the water present, thus liberating the oxygen, which, in its nascent state, is able to decompose the coloring matter by taking its hydrogen and carbon. In many instances of chlorine bleaching, these processes take place simultaneously, and are not in the least incompatible with each other.

Oxygen, as it exists in the atmosphere, sometimes bleaches (and sometimes dyes) by virtue of its affinity for elements or compounds contained in the colored matter.

Cyanide of potassium, as recommended in the September number of the *Dental Cosmos*, 1861, by Dr. Kingsbury, bleaches by virtue of the affinity of its cyanogen for hydrogen. Cyanide of potassium is readily decomposed. Its solution undergoes "spontaneous decomposition," even in closed vessels. Its cyanogen, with the energy incident to the nascent state, is able to remove hydrogen from almost any organic compound. Its mode of bleaching is exactly the same as that of chlorine.

Dr. K.'s caution in regard to the poisonous properties of the cyanide are worthy of attention; and the doctor, as well as all others, should know that it bleaches only by forming hydrocyanic acid, the most deadly poison known.

But it is not our intention to write an essay on the subject of bleaching now and here. We set out merely to tell how glad we are that the subject is eliciting increased attention.



## CALCIUM AND ITS COMPOUNDS.

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CALCIUM,  $\text{Ca} = 20$ .—From force of habit we are apt to regard the metals as derived solely from the inorganic kingdom of nature. The one now under consideration, however, like several others, is found in both divisions of the organic. This metal, indeed, performs no inconsiderable part in the great play of life; and, when this is borne in mind, an intimate acquaintance with it and its compounds cannot be otherwise than interesting.

Though so abundant and so extensively diffused, it is not found uncombined. Its strong affinity for the highly electro-negative elements, such as oxygen and fluorine, and the difficulty with which it is separated from them, explain the fact of its recent discovery. Its existence was unknown till the early part of the present century.

Calcium is a yellowish-white metal, having the color and lustre of gold heavily alloyed with silver. Its lustre is soon tarnished by the oxygen of the atmosphere, especially in damp air, when its yellowish tinge is more perceptible. It is ductile and malleable, and about as hard as silver. It burns with a bright flash when heated on platinum; and, when heated, burns brilliantly in oxygen, chlorine, iodine, sulphur, etc. It decomposes water rapidly, with the evolution of hydrogen and the formation of hydrate of lime. Calcium is usually obtained by decomposing its chloride by galvanic action. Its specific gravity is about 1.58; and it melts only at a high temperature. On account of its strong affinities, the metal is of



no use in the arts; and as there are other and more convenient deoxydizers, it is but little used in the laboratory.

**Lime,  $\text{CaO} = 28$ .**—Calcium forms two compounds with oxygen, the protoxyd and the binoxyd. The former is called lime, and is extensively used both in the laboratory and the arts. It is commonly obtained by heating the carbonate of lime to redness in lime-kilns. For use in the laboratory it should be prepared from calcareous spar or fine marble, by heating in an open crucible. When thus prepared it consists of porous masses of a white color, sufficiently cohesive to bear transportation, and two or three times as heavy as water. Lime is infusible in the furnace, and but partially fusible in the oxyhydrogen flame. It is a strong basic oxyd, and turns reddened litmus blue. It has a strong affinity for water, and is used to separate this liquid from alcohol and kindred substances.

**Hydrate of Lime,  $\text{CaO}, \text{HO} = 37$ .**—When water is thrown upon massive lime, as prepared above, it is first imbibed, as it would be by other porous bodies, but soon unites chemically with it, forming a new compound. The lime falls to powder, greatly increased in bulk, and is then said to be slaked. And it is worthy of notice that though twenty-eight parts of lime have united with nine of water, there is no moisture present. By combination, the water has become a part of a dry solid. And, in accordance with a universal law, that when a liquid is condensed into a solid, latent heat is liberated, and an increase of temperature is the result, by the slaking of lime, sufficient heat is evolved to char wood, and even to produce actual ignition.

Hydrate of lime is slightly soluble in water, and is one of the few substances more soluble in cold than in hot water. One grain of the hydrate is held in solution by 778 grains of water at  $60^{\circ}$ , while it requires 1270 grains of boiling water to accomplish the same result. By slowly



evaporating the solution in vacuo, small transparent hexahedral crystals of the hydrate may be obtained.

Lime-water is readily prepared by adding an excess of the hydrate to distilled, or clean rain-water, and repeatedly agitating the mixture for a few days. When left to settle the excess falls to the bottom, and the clear solution may be carefully decanted, or drawn off with a syphon.

Lime-water absorbs carbonic acid from the atmosphere, and becomes covered with a thin pellicle of carbonate of lime. A portion of this carbonate also falls to the bottom of the vessel in the form of powdered chalk. When hydrate of lime is for a long time exposed to the atmosphere a half an equivalent of carbonic acid is absorbed by it, and a definite compound of the carbonate and hydrate is formed, as represented by the formula,  $\text{CaO}, \text{CO}_2 + \text{CaO}, \text{HO}$ .

Lime-water is often a valuable remedy for an acid state of the secretions. Often when the local use of alkaline carbonates fails to arrest an acid state of the secretions of the mouth, the internal use of lime-water, for a few days or weeks, acts like a charm. We usually prescribe it in teaspoonful doses three times a day, after eating, though, of course, the dose must be varied to suit the age of the patient and the peculiarities of the case. And, as most dentists are not physicians, it will be advisable to act through, or obtain the consent of the family physician. The taste of lime-water is too harsh and acrid to admit of its use as a local remedy in acidity of the mouth; but this is not to be regretted while the carbonate of lime—prepared chalk—accomplishes all that it could.

**Carbonate of Lime,  $\text{CaO}, \text{CO}_2 = 50$ .**—This salt sometimes pure, but often commingled with other substances, is found abundantly in nature. It exists in the forms of calcareous spar, marble, chalk, limestone, etc. As thus found the salt is anhydrous; but a hydrated carbonate of



lime may be obtained by slightly heating together 1 part of hydrate of lime, 6 parts of water, and 3 of sugar, filtering the solution, and exposing it for a week or two to the atmosphere in a shallow vessel. The carbonic acid is obtained from the atmosphere; and the hydrated salt crystallizes with five equivalents of water. The crystals are acute rhombohedrons.

Carbonate of lime is nearly insoluble in pure water, but dissolves, to a considerable extent, in water charged with carbonic acid. On this account it is generally present in the water of wells and springs, and is precipitated from it by boiling, which expels the excess of carbonic acid. The same result takes place when the water is evaporated at low temperatures, or even when it is exposed to the atmosphere. For example, when the water flows over wood, or other destructible substances, the forms of these substances are preserved in calcareous deposits of carbonate of lime. When a current of carbonic acid is forced through lime-water the lime is precipitated in the form of powdered carbonate; and if the supply of the acid is kept up, most of the powder will be redissolved.

On account of the elasticity of carbonic acid, the carbonate of lime (as well as other carbonates) is easily decomposed by the application of heat, or a less volatile acid. In the ordinary preparation of lime the heat simply drives off an equivalent of carbonic acid. If, however, the carbonate be hermetically sealed in an iron tube, and heated, it may be fused without undergoing decomposition. If the tube is cooled slowly the salt crystallizes and resembles marble.

Carbonate of lime performs important offices in the animal economy. It is an essential constituent of the bony tissues, and the principal ingredient of the shells of mollusks. As a constituent of the teeth it is interesting to the dentist. All acids capable of acting on the calcareous



portion of the tooth decompose the carbonate, liberating the carbonic acid. In other words, the action of an acid on this salt in the tooth differs in no respect from its action on the same salt in any other situation. Hence, with hydrochloric acid chloride of calcium is formed, with sulphuric, sulphate of lime, and so on, through the entire catalogue of acids capable of corroding the teeth.

It would be interesting to inquire how this salt is introduced into the system. True, most men and other animals drink water strongly impregnated with it; but it is quite probable that much of it is formed from other salts of lime, introduced with vegetable food. It is the opinion of most physiological chemists that free carbonic acid may be found in all the animal fluids; and, if this be true, they would have no difficulty in holding the carbonate in solution, ready for assimilation.

**Sulphate of Lime**,  $\text{CaO}, \text{SO}_3 = 68$ .—When sulphuric acid is added to any soluble salt of lime this salt is precipitated as a bulky white powder. It is also found in nature in two conditions. When composed as indicated in the above formula it is called *anhydrite*; but it is found more abundantly in combination with water, as represented in the formula,  $\text{CaO}, \text{SO}_3 + 2\text{HO}$ , when it is called *gypsum*, or plaster of Paris. Gypsum, or the hydrated sulphate, is more important and interesting to the dentist than the anhydrous.

Sulphate of lime is but slightly soluble in water, nearly five hundred grains of the liquid being required to dissolve a single grain of the salt. It fuses at a strong red or white heat without decomposition; but when thus heated in contact with charcoal its oxygen is all expelled, and the protosulphide of calcium ( $\text{CaS}$ ) is formed, which is a whitish salt, nearly insoluble in water.

The native gypsum is broken into small fragments, and heated in ovens or kilns to a temperature of  $240^\circ$  to  $260^\circ$ ,



and afterward reduced to powder. It is then the “plaster” of our laboratories. When heated to  $300^{\circ}$ , or with some specimens even to  $270^{\circ}$ , it parts with all of its water, and fails to recrystallize when mixed with water, and, therefore, becomes useless in the laboratory.

Much of the gypsum found in nature is impure. That found in the vicinity of Paris, according to Regnault, contains—

Sulphate of lime.....	70.39
Water.....	18.77
Carbonate of lime.....	7.63
Clay.....	3.21
	<hr/>
	100.00

Other foreign substances are found in some specimens, which may account, to some extent, for the imperfect recrystallization of some varieties of plaster. The gypsum must have the proper composition, and must be properly calcined in order to obtain a perfect plaster. When thus prepared, if the plaster is mixed with water to the consistence of a thin paste, a chemical union takes place between the water and the sulphate, by which the paste is converted into a solid mass of gypsum. This crystallization is commonly called *setting*. In setting plaster expands slightly, and is thus forced into all the inequalities of an ordinary mould. The degree of expansion differs with different varieties. The experiments of Prof. Buckingham, as reported in the *Dental Cosmos*, are the most satisfactory of any we are aware of, with reference to this expansion, and we refer the curious to them. It is satisfactory to know that it is of no practical importance to the dental laboratory.

When plaster sets, the combining water is condensed from a liquid to a solid, and, of course, latent heat is liberated. The consequent elevation of temperature is quite



perceptible, but is less than when hydrate of lime is formed.

Pure crystallized gypsum is sometimes called *selenite*; and a white compact variety of it, used in statuary ornaments, is called *alabaster*.

The various uses of plaster, and the modes of using it in the dental laboratory, belong to the mechanic rather than to the chemist. Fortunately there is no lack in this direction, and we, accordingly, refer the reader to resources already familiar to him.

**Phosphate of Lime**,  $3\text{CaO}, \text{PO}_5 = 156$ .—Phosphoric acid and lime unite in several proportions; but it is not intended to notice, specially, in this connection, any but the salt indicated by the above formula, which is a subphosphate, and is commonly called, for sake of definiteness, *bone phosphate*.

Bone phosphate may be formed artificially by adding a solution of chloride of calcium to a solution of the rhombic phosphate of soda; but as it exists abundantly, ready formed in bones, it is usually obtained from this source. When bones are fully calcined in open vessels the organic matter is all driven off and a white ash remains. Bone ashes are usually composed of four-fifths of subphosphate and one-fifth of carbonate of lime. For separating the two salts the process of the Dublin College is as convenient as any other. The bone ash is reduced to powder and dissolved in highly diluted hydrochloric acid. When the acid is saturated the solution is filtered, and ammonia is added as long as a precipitate is thrown down. Afterward wash and dry the precipitate. The carbonate of lime contained in the ash is decomposed by the action of the hydrochloric acid, as indicated by the following formula:  $\text{CaO}, \text{CO}_2 + \text{HCl} = \text{CaCl} + \text{HO} + \text{CO}_2$ .

The carbonic acid being liberated escapes as a gas, and the chloride of calcium, being highly soluble, is easily re-



moved by washing. The precipitate is the subphosphate under consideration.

This salt is a white, tasteless, odorless, gritty powder. It is insoluble in water, but dissolves in hydrochloric, nitric, acetic, and lactic acids, without decomposition, and may be precipitated from its solution in any of these acids by the alkalies or their carbonates. At a very high heat it fuses without decomposing.

As this salt is the principal earthy ingredient of the teeth, an accurate knowledge of its properties and affinities is of vast importance to the dental surgeon. And it is worthy of notice by all that, in the formation of the teeth and osseous tissues in general, the great Creator selects, as the principal solid constituent, a salt so permanent in its composition—a salt that can sustain white heat, or solution in the most active acids, without change.

In the study of the chemistry of caries this salt and the carbonate are the only solid ingredients of the tooth necessary to be taken into consideration; for the others are present in such small quantities that they produce no practical or observable results. And it is time that all notions about other acids displacing the phosphoric, and taking the lime, were abandoned; for no acid directly concerned in the production of caries takes the lime from the phosphoric unless it be sulphuric acid; and it can do so only in favorable circumstances. But they do take the lime and the phosphoric acid along with it. The direct action of an acid in producing caries, as far as the earthy constituents of the tooth are concerned, is exactly the same as its action on bone ash. It is true, the pulverized condition or porosity of the ash favors the action of the acid by promoting contact; but if an acid acts at all on the solid constituents of the tooth, it acts precisely as it does on the same substances out of the mouth. Let it be borne in mind, then, that hydrochloric, nitric, and lactic



acids all dissolve the phosphate of lime—that is, they *combine* with it, forming soluble compounds, while the same acids *decompose* its accompanying carbonate. The action of these acids should be understood and remembered, for the teeth are oftener destroyed by them than by any others.

Writers on therapeutics sometimes express a want of confidence in the efficacy of this salt as a remedy for a lack of it in the system, on account of its insolubility, apparently forgetting its high degree of solubility in hydrochloric acid, which is present in the gastric juice.

That the phosphate of lime performs important offices in the animal economy may be inferred from its extensive diffusion through the system. According to Lehmann, “there is no animal tissue in whose ash or incineration we do not find phosphate of lime.” And the importance of furnishing an abundant supply of it in certain conditions of the system, either in the food or otherwise, is worthy of the most serious attention; but to pursue this vein would lead beyond the range of the present paper. Lehmann, vol. i. p. 374, says: “We need hardly remark that rachitis frequently, if not always, occurs simultaneously with the period of dentition, that the consumption of phosphate of lime during pregnancy is often so great that scarcely any traces of it can be found in the urine, and that, during this period of woman’s life, fractures unite with extreme difficulty, and sometimes do not unite at all.”

The proper consideration of this salt, in all its relations to dental surgery, would require a separate paper.

**Hypochlorite of Lime**,  $\text{CaO}, \text{ClO} = 71$ .—This salt is extensively used in bleaching. When milk of lime, in excess, is added to a solution of hypochlorous acid, it is obtained pure. The commercial chloride of lime, often called *bleaching powder*, is a mixture of hydrate of lime,



chloride of calcium, and hypochlorite of lime. It is usually prepared by passing chlorine slowly over hydrate of lime. The reaction which takes place may be represented as follows :



An excess of lime must always be present, for if the supply of chlorine is continued after the lime is all changed into chloride of calcium and hypochlorite of lime, the hypochlorite is decomposed, with the formation of chloride of calcium and a chlorate of lime, thus :



The hypochlorite of lime and the chloride of calcium being soluble, can be readily separated from the hydrate of lime by washing. According to Graham, ten parts of water take up the bleaching combination of one part of the commercial chloride ; but, of course, the proportions must vary, for some specimens contain a much greater excess of the hydrate of lime than others. The solution thus obtained has the odor of hypochlorous acid, an astringent taste, and an alkaline reaction. It decomposes most organic matters containing hydrogen, and therefore destroys most coloring matters.

Hypochlorite of lime is not a permanent compound. Most of the acids decompose it, taking the lime. The carbonic acid of the atmosphere acts in this way ; and the consequence is that hypochlorous acid is constantly liberated. Even the acid is not permanent, but is slowly decomposed, at ordinary temperatures, with the evolution of chlorine ; and this decomposition is greatly facilitated by exposure to light.

In bleaching with this salt a number of reactions occur. The lime may be regarded merely as the pilot or engineer that conducts the acid to the place where its action is desired. Its direct action in promoting or retarding the bleaching process is of no practical importance. Chlorine



has long been recognized as the great bleacher; but disputes have arisen as to how it bleaches. Some maintain that, by its affinity for hydrogen, it decomposes water, and the liberated oxygen, with the advantage of its nascent condition, does the bleaching. Others claim that it takes the hydrogen of the coloring principle, and thus bleaches directly. But there is no occasion for dispute; for both positions are correct. And this may enable us to understand the reactions of bleaching by hypochlorite of lime, or, in other words, by hypochlorous acid.

It has been stated that the hypochlorite is constantly giving off the acid; and, also, that the acid itself is decomposed under all ordinary circumstances. Now, bearing in mind that this acid is composed of one equivalent of oxygen and one of chlorine, by its decomposition these active elements are simultaneously liberated, having equally the advantage of the nascent state, and, therefore, far more energetic than if previously free; the oxygen spends its force by taking the hydrogen and carbon from the coloring principle, while the chlorine either takes hydrogen from the coloring matter or from the water present, in which case another equivalent of nascent oxygen is set to work. From this it will be seen that one equivalent of hypochlorite of lime (containing, of course, one equivalent of hypochlorous acid) has as much bleaching power as two equivalents of free chlorine, or two of nascent oxygen.

With these principles understood the dentist can readily appreciate the action of the hypochlorite in bleaching teeth. It is pretty generally conceded that the coloring principle here is hematin, the composition of which is  $C_{44}H_{22}N_3O_6Fe$ . By a single glance at the formula it will be seen that the chlorine may take its hydrogen, or the oxygen, both its carbon and hydrogen.

The hypochlorite is also valuable as a deodorizer; and



it acts, in this direction, by virtue of the same properties and affinities which govern its action as a bleacher.

The remaining salts of lime, such as the nitrate, chlorate, etc., are not possessed of sufficient interest to be noticed here; and as there is no effort at system in this paper, the consideration of them is omitted.

**Chloride of Calcium,  $\text{CaCl} = 55$ .**—By dissolving carbonate or hydrate of lime in hydrochloric acid, chloride of calcium is formed. With the carbonate the reaction is as follows:



The carbonic acid escapes as a gas, and the chloride may be crystallized by evaporation. No other compound of chlorine with calcium is known. When a solution of this chloride is strongly concentrated by evaporation, and allowed to cool, large crystals of the hydrated salt are deposited, each equivalent of the salt being united with six of water.

The crystallized salt is very deliquescent, and when mixed with pounded ice (or snow), by virtue of its great affinity for water both it and the ice are rapidly liquefied, producing an intense degree of cold, sinking the thermometer, according to some experimenters, as low as  $-49^\circ$ .

The crystallized salt is valuable in making frigorific mixtures. It is conveniently prepared by saturating diluted hydrochloric acid with chalk or marble dust, and evaporating the solution till a drop of it, let fall on a marble or porcelain slab, instantly congeals. The whole mass is then cooled, and the crystals reduced to powder and put into well-stopped bottles.

When heated, the hydrated salt fuses in its water of crystallization; and at  $400^\circ$  parts with four equivalents of its water and forms a porous mass, which has a great affinity for water and is extensively used for drying gases and other kindred offices in the laboratory. It fuses at a



red heat, having parted with all its water. The fused chloride has a strong affinity for water, and a large quantity of latent heat is liberated by its combination with that liquid.

Chloride of calcium is among the most soluble of salts; and as it is one of the salts formed by the action of hydrochloric acid on tooth-bone, it will be readily understood how it is that acid dissolves out the earthy matter, leaving the organic. It is also soluble in and forms a definite compound with alcohol.

**Fluoride of Calcium,  $\text{CaF} = 39$ .**—This compound is found in nature, sometimes in well-defined crystals, and at other times in solid masses of various and variegated hues. It is often called *fluor spar*. When reduced to powder and heated it becomes luminous far below a red heat, evolving a violet or green light. This fluoride fuses at a red heat without decomposition, and is acted on but slightly by nitric or hydrochloric acid, but it is decomposed by sulphuric acid, aided by a gentle heat. Its principal use in the laboratory is in the preparation of hydrofluoric acid. It is used in the arts in forming vases and ornaments.



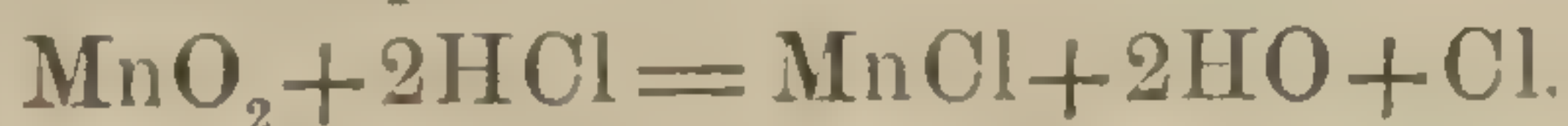
## CHLORINE.

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CHLORINE, under ordinary circumstances, is a greenish-yellow gas. Its name is derived from the Greek word which expresses its color. When reduced by pressure to one-fifth its ordinary volume it becomes a liquid, whose density is 1.33. It has not yet been congealed. The density of the gas is 2.44.

Chlorine was discovered in 1774 by Scheele, who called it "*dephlogisticated marine acid*," and was supposed to consist of muriatic acid and oxygen. About 1809 or 1810 it was classed by Davy with the simple bodies, and this position is now universally assigned it by chemists. Chlorine is usually obtained by the action of hydrochloric acid on binoyd of manganese.

Equal parts of the two ingredients may be put into a retort, and heat applied. The gas may be collected from the discharging tube over warm water; but it is better to collect it in dry bottles by displacement of air. The reaction which takes place is as follows :



The affinities which determine these changes are the mutual attractions of oxygen and hydrogen, and of chlorine and manganese.

Distilled or recently boiled water dissolves twice its volume of chlorine, and yields it again when heated. This solubility renders it impracticable to preserve it over water, and its affinity for mercury prevents its being collected over that metal.



Chlorine has an astringent taste and a disagreeable odor. It is one of the most suffocating gases, causing spasm of the glottis and great irritation, even when considerably diluted. Light produces no effect upon it when dry, but if water be present its hydrogen combines with the chlorine, forming hydrochloric acid. Hence the necessity of keeping solutions of chlorine in the dark is manifest.

Chlorine has powerful affinities. It unites energetically with hydrogen, and on this property depend many of the chemical phenomena to which it gives rise. An explosion always takes place when a lighted taper is plunged into a mixture of these two gases. It acts powerfully on the metals, readily converting them entirely into chlorides. Most of them combine with it even in the cold, and so energetic is the combination with many that the temperature rises to ignition. Many substances take fire when thrown in a finely powdered state into a bottle filled with chlorine, and hence it may be called a supporter of combustion.

Chlorine is indirectly a most powerful oxydizing agent. Thus, when chlorine and a body which has a strong affinity for oxygen are brought in contact, water is usually resolved into its elements, its hydrogen uniting with the chlorine, and its oxygen with the other body.

When a compound of chlorine and an inflammable substance is traversed by a galvanic current, the inflammable body goes to the —, and the chlorine to the + pole. A close analogy is thus established between oxygen and chlorine, both are negative electrics, and both supporters of combustion.

Chlorine is extensively used in the arts for bleaching linen and cotton fabrics, and, in general, for destroying animal and vegetable colors. These coloring matters, like all other organic substances, are composed of carbon,



hydrogen, oxygen, and sometimes of nitrogen. Chlorine generally decomposes them by appropriating their hydrogen to form hydrochloric acid. In some cases, however, it seems that there is no bleaching in the absence of moisture. It is probable, then, that the oxygen, liberated by the decomposition of the water, is the bleaching agent.

Chlorine is extensively used for fumigation. For destroying miasmatic, noxious effluvia and putrid odors it is the best agent known. It acts as a poison on the animal system, both when inhaled and when swallowed. It should therefore be handled with due caution.

The compounds of chlorine, which are not acid, are called chlorides. Some of its combinations are interesting and important to the dentist. A few only will be noticed at present, and these without much regard to system.

**Hydrochloric Acid, HCl.**—A concentrated solution of this acid is the *muratic, chlorohydric, or hydrochloric acid of commerce*. In its purer form of gas it was discovered by Priestly in 1772. It is conveniently obtained by putting a portion of the hydrochloric acid of commerce in a glass flask, and heating it till the liquid boils, when the gas is freely evolved, and may be collected over mercury. It cannot be collected over water. It is also prepared by the action of concentrated sulphuric acid on common salt. The gas is freely disengaged by the application of heat. In the former case the hydrochloric acid, previously dissolved in the water, is simply expelled from it by heat. The reaction in the latter case is represented by the following equation :



Hydrochloric acid may be generated by the direct combination of its elements ; a mixture of equal volumes of the two gases unites by explosion on the introduction of flame, a red-hot body, spongy platinum, or by the passage



of an electric spark. Even in diffused light they combine, but without explosion.

Hydrochloric acid is colorless, gives off copious fumes, which are formed by the acid uniting with the water of the atmosphere. It has a pungent odor and an acid taste, is irrespirable, exciting violent spasm of the glottis, extinguishes burning bodies, and is not inflammable.

It is not chemically changed by heat, but is readily decomposed by galvanism, hydrogen appearing at the —, and chlorine at the + pole. A striking property of the gas is its attraction for water, which at 32° absorbs more than 500 times its volume of it. Ice is instantly liquefied by it. The density of the liquid acid concentrated in the cold is 1.21.

The hydrochloric acid of commerce is seldom pure, generally showing a yellowish tinge, caused by the presence of iron, and it frequently contains a small quantity of sulphurous acid. It is readily purified by distillation. The sulphurous acid may be converted into the sulphuric by passing a few bubbles of chlorine through the solutions, and the sulphuric is precipitated, as sulphate of baryta, by chloride of barium.

A solution of the pure acid is perfectly colorless. In cases of poisoning by hydrochloric acid the antidotes are chalk, whiting, magnesia, soap, etc.

#### COMPOUNDS OF CHLORINE AND OXYGEN.

Both chlorine and oxygen manifest an energetic attraction for most elementary substances, yet they have but a slight affinity for each other; they are consequently not found, in nature, in a state of combination. They cannot be made to combine directly, and when united, very slight causes separate them.

They form several combinations, five of which are well



ascertained, and are possessed of acid properties. These are :

1. Hypochlorous acid,  $\text{ClO}$ .
2. Chlorous acid,  $\text{ClO}_3$ .
3. Hypochloric acid,  $\text{ClO}_4$ .
4. Chloric acid,  $\text{ClO}_5$ .
5. Perchloric acid,  $\text{ClO}_7$ .

Of these we will notice, at present, only

**Chloric Acid,  $\text{ClO}_5$ .**—When a strong solution of potassa is saturated with chlorine, white crystals of chlorate of potassa are separated after standing, while a large quantity of chloride of potassium and a small quantity of chlorate of potassa remain in solution. The reaction which takes place is as follows :



To purify the chlorate, dissolve it in boiling water ; the greater part of it will be deposited in crystals as the liquid cools.

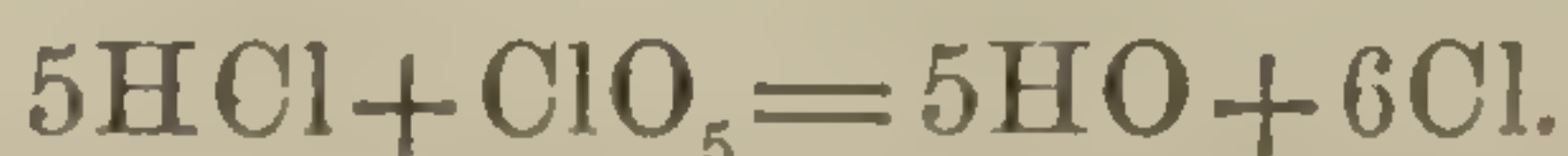
All the compounds of chlorine and oxygen are prepared from the chlorate of potassa. Chloric acid is prepared by adding to a solution of chlorate of potassa hydrofluosilicic acid. The gelatinous silicofluoride of potassium is precipitated, and chloric acid remains in solution. But as the silicofluoride is a transparent precipitate, it is difficult to know when the potassium is entirely precipitated, and the hydrofluosilicic acid is therefore likely to be used in excess ; hence the liquid containing hydrofluosilicic and chloric acids should be filtered and saturated with a solution of baryta, which forms an insoluble hydrofluosilicate with the one, and a soluble chlorate with the other. The liquid is again filtered and evaporated, and the chlorate of baryta is obtained in crystals. The chloric acid may then be separated by dissolving the chlorate in water, and adding sulphuric acid as long as a precipitate is formed. The sulphate of baryta may be separated on a



filter, and the liquid which contains only chloric acid may be evaporated to the proper consistence, under the receiver of an air-pump.

Chloric acid is readily decomposed by heat, or by the presence of deoxydizing agents. At a little above  $100^{\circ}$  it is converted into perchloric acid ( $\text{ClO}_7$ ) and chlorous acid ( $\text{ClO}_3$ ). At a still higher temperature it is resolved into its elements. Sulphurous acid deprives it of oxygen, with the formation of sulphuric acid and the evolution of chlorine.

By mixing chloric with hydrochloric acid, chlorine is copiously liberated, as may be illustrated by the following equation :



This mixture is an admirable solvent for gold, platinum, etc., but the inconvenience of preparing, and the difficulty of preserving the chloric acid, renders its use impracticable in most cases.

**Aqua Regia.**—Chlorine is also freely disengaged from a mixture of nitric and hydrochloric acids. This well-known mixture was called by the alchemists *aqua regia* (royal water), from its power to dissolve gold, which they regarded as the *king* of metals. It may be made by mixing 1 volume of nitric with 2, 3, or 4 volumes of hydrochloric acid.

When *aqua regia* acts on any metal, the following reaction takes place between the two acids of which it is composed :



A metal placed in this liquid therefore meets chlorine in its nascent state, and is in consequence rapidly dissolved into the state of chloride.

The metallic chlorides might be considered with more propriety, perhaps, under the various metals, but as this is an isolated article, I will notice a few of them here.



**Chloride of Sodium, NaCl.**—This well-known table-salt may be formed directly by heating sodium in hydrochloric acid gas, by burning the metal in chlorine, or by neutralizing soda with hydrochloric acid. It is the chief saline ingredient of sea-water, and exists as a mineral under the name of rock-salt, and is contained in many saline springs. Obtained from any of these sources it contains traces of sulphate of magnesia and lime, and chloride of magnesium. These may be precipitated as carbonates by boiling a solution of the salt with an excess of carbonate of soda, then by filtering the liquid and neutralizing with hydrochloric acid pure chloride of sodium is obtained.

When a solution of chloride of sodium evaporates spontaneously, the crystals are regular cubes, but when the process is rapidly conducted, they are hollow four-sided pyramids, formed by the adhesion of minute cubes. They contain no water of crystallization.

This salt is also found in the organized kingdom, as in saline plants, and in the blood, saliva, urine, etc. of man, and many of the lower animals.

Its general use is well known. The dentist uses it in the laboratory to precipitate silver, as a chloride, and some use it as a dentifrice—a practice of at least doubtful utility.

**Chloride of Zinc, ZnCl.**—When minutely divided zinc is introduced into chlorine gas they combine with the evolution of heat and light, and this salt is formed. It is readily and cheaply prepared by dissolving the metal or its oxyd in hydrochloric acid, evaporating to dryness and fusing the residue in a narrow-necked glass vessel.

Chloride of zinc is a grayish-white, soft, semi-transparent mass. It is soluble in water, alcohol, and ether. It fuses a little above  $212^{\circ}$ , and sublimes at a red heat. It is highly deliquescent.

Its local action on living tissue is that of an escharotic.



This action depends principally on its affinity for albumen and gelatine. As a caustic it is exceedingly active, decomposing the organic tissues as rapidly as nitrate of silver, extending its action at the same time to parts more deeply situated.

This salt is extensively used as an escharotic application to inflamed dentine. The subjacent tissues are left in a healthier condition after its use than after nitrate of silver and some other caustics, but the loss of substance is greater.

The oxychloride of zinc, made by simply dissolving zinc in hydrochloric acid, is a good flux for almost any of the soft solders which the mechanical dentist may wish to use incidentally in the laboratory.

**Chloride of Silver,  $\text{AgCl}$ .**—This compound, known as horn-silver by mineralogists, may be generated by heating silver in chlorine gas, or by mixing hydrochloric acid or any soluble chloride with a solution of nitrate of silver. The most convenient precipitant is the chloride of sodium or common salt. When common gold coin or any alloy containing silver is dissolved in aqua regia, the silver is found at the bottom of the vessel in the form of chloride. When first precipitated it is white, but by exposure to light it soon becomes almost black.

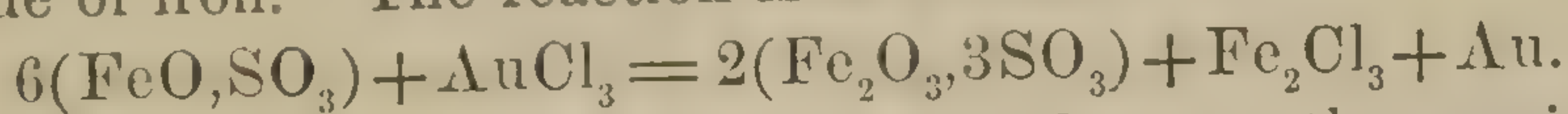
It is insoluble in water, and but sparingly soluble in the stronger acids. It is readily dissolved in ammonia. It fuses at about  $500^{\circ}$ , and is then a yellow liquid, which on solidifying becomes a semi-transparent horny mass, identical with the native horn-silver. It bears almost any degree of heat without change, but is readily decomposed by hydrogen. A convenient method of effecting this is to place the chloride in a glass jar, add granulated zinc and dilute sulphuric acid. The hydrogen thus disengaged seizes the chlorine, forming hydrochloric acid, which escapes as gas, leaving the silver in minute granules in



the bottom of the jar. The zinc must all be dissolved by the sulphuric acid, and the sulphate of zinc, being soluble, is easily removed by washing and decantation. This decomposition is thus illustrated:



**Terchloride of Gold,  $\text{AuCl}_3$ .**—When gold is dissolved in aqua regia, and the solution is sufficiently concentrated by evaporation, very fusible red crystals are obtained. These are composed of the terchloride of gold. Into this form gold is usually and most conveniently dissolved. It is readily decomposed by protosulphate of iron, by which the metal is thrown down as a brown powder, and the solution contains sesquisulphate of peroxyd and perchloride of iron. The reaction is as follows:



Slight traces of iron sometimes adhere to the precipitate, but they are easily removed by washing with dilute hydrochloric or sulphuric acid.

Nitrate of mercury, most of the metals, sulphurous, phosphorous, and oxalic acid also decompose it, and precipitate the gold.

The terchloride of gold is soluble in water, alcohol, and ether. The ethereal solution is an admirable escharotic application to inflamed dentine. The indications for its use are the same as those for chloride of zinc. It is conveniently prepared by evaporating the ordinary solution of gold till the formation of crystals commences; then dissolve the residue in water, and add, in a vial, an equal volume of sulphuric ether, and agitate. Two fluids will result, the lighter of which is the ethereal solution of terchloride of gold. It may be poured into a separate vial, closely corked, and set in a dark place for future use. The gold may be precipitated from the remaining solution with sulphate of iron.

When the ethereal solution is applied to a tooth, the



terchloride is almost instantly decomposed, and the three equivalents of chlorine, thus liberated, act with the energy peculiar to the nascent state, and the result is that the vitality of the inflamed dentine is instantly destroyed, and with far less pain than results from chloride of zinc, or any other escharotic that I have used. It is probable also that the presence of the ether has some influence over the pain.



## SPIRIT LAMP EXPLOSIONS.

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SINGULAR and erroneous ideas in regard to the explosions of spirit lamps seem to be quite prevalent, both in and out of the profession. This remark is suggested by a notice, in the July number of the *News Letter*, of a serious accident occurring to a distinguished member of the profession in New Orleans. We are surprised that so few explosions occur when we consider the structure of many of the lamps in use. That style, with various slight modifications, called by Piggott "the common form of the dentist's lamp," and represented on page 241 of his "Dental Chemistry," is extensively used in some parts of the country. Now, why should it not explode? for, like the Irishman's Niagara, "it has nothing to hinder it," as will be seen at a glance by all who understand the cause of the explosions.

After noticing the accident, one of the editors of the *News Letter*, like ourselves, feeling "inclined to say a word," winds up as follows:

"Lamps should have a spout of good length, should be kept, when using, well filled, and the wick should fit tightly, not so tightly, however, as to prevent the necessary absorption of the fluid—and should extend the whole length of the spout at least. A vent in the top of the lamp is also desirable."

We like all these suggestions very much, *except the "vent."*

Before proceeding further, allow us to state that alcohol,



whether in liquid or vapor, is not explosive. The lamp may become heated, or the fluid in it take fire, and it will boil over, perhaps with sufficient force to throw the lid off the "ordinary lamp;" if not, the liquid will run out at the spout, and, of course, it will burn. This, however, is not explosion; yet it is all that can be done toward it with alcohol, either in liquid or vapor, in an ordinary lamp.

Now, some may be as much startled at this as if we had presumed to answer that eternally open question, "Will saltpetre explode?" Well, when saltpetre is properly combined, in due proportions, with charcoal and sulphur, the question is no longer *open*, but the mass, assisted by a spark, is able to open almost anything which attempts its confinement. So, while neither alcoholic vapor nor atmospheric air is explosive, a mixture of the two, within certain proportions, is highly so.

Here, then, lies the whole secret. The vapor is combustible, but, for want of a supporter, it can, ordinarily, burn only at the surface. But, when mixed with air, each atom of the combustible is in contact with a supporter of combustion, and the whole mass is instantly ignited, and an explosion is the consequence. Now, it is readily inferred that any form of lamp, even the most defective, may be used many times without an explosion, simply because the necessary mixture of air and vapor does not often take place. But when the mixture, in proper proportions, is present, the flame will reach it in spite of *tight wick or long spout*, as these terms are usually understood. The class of 1853 and 1854 in the Ohio College will remember a slight (?) explosion in the lecture-room, when the flame, to reach the reservoir, penetrated a blow-pipe fifteen inches in length, with an unusually small orifice.

If the lamp becomes heated in using, the space above the fluid is filled with vapor. As it cools, this is condensed and a partial vacuum occurs. The equilibrium is restored



by an influx of air, unless, by the structure of the instrument, this is prevented. Now, if the mixture be in explosive proportions, the explosion takes place when the lamp is again lighted. Sometimes the proportion of vapor is too small, and the accident does not occur till, by heating the lamp, its quantity is increased. The influx of air, however, is usually too slight to form an explosive mixture, and on this principle alone can the exemption from accident be explained.

The precautions we usually recommend are, to construct the lamp so that the body of it is not liable to be heated to any extent by use, so that the entire diameter of the spout will be filled as long as any fluid remains in the lamp, and so that the admission of air above the fluid can be totally prevented. The "vent in the top of the lamp" we think decidedly increases the danger.



## THE AMALGAM QUESTION.

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THAT various morbid symptoms may be produced by what is commonly called mercurial poisoning, is no longer doubted; but it is still a question whether or not free mercury is poisonous. Christison and others maintain that it is not; while Orfila, Buchner, Pereira, and others maintain the opposite. The question is, however, of but little practical moment; for all these, and everybody else, agree that many, if not all, of the compounds of mercury are poisonous. It is well known that the *metal* applied externally, or inhaled in the form of vapor, will produce constitutional effects; but whether or not it loses its metallic state, by combination with some other element, before it acts thus on the system, is not yet determined.

Salivation, ulceration, and sloughing, and shaking palsy (*tremor mercurialis*) are the diseases most frequently produced by the action of mercury; and of these, the first is much the most frequent. The last mentioned is usually produced by the long-continued and very gradual introduction of the drug into the system. Gilders, barometer and looking-glass manufacturers, and workers in quicksilver mines are frequently affected with this disease; and, if their occupations are not abandoned, more formidable and usually fatal diseases supervene.

An important practical question arises as to how much of the metal, or how much of any one of its compounds is necessary to produce observable constitutional effects. And here it is well known that striking differences will be



manifested by different constitutions. Some persons can take large mercurial doses without inconvenience, while others are poisoned by very minute quantities. Accidental causes no doubt have often great influence; and the whole question is to some extent involved in difficulty, as we are not able to define, positively, the mode of action of this powerful drug. It is evident that the metal is absorbed and deposited in some part of the system, or is thrown out by excretion. And as there may be great variations in the absorbing and excreting powers of the same person at different times, it is not strange that the same constitution is more susceptible of the action of mercury sometimes than others. Mercury, according to Schubarth, Weller, and others (see Christison on Poisons), has been detected in the blood, in the sweat, the saliva, in the urine, the bile, the intestinal secretion, and in the fluid of ulcers. It has also been found, in its metallic state, in the bones, brain, pleura, lungs, cellular tissue, synovial tissues, the humors of the eye, etc. And it is evident that its constitutional effects are owing to its absorption; for these are the same, whether the mercury is applied to the skin, to the mucous membrane, or injected into the veins.

Bearing these things in mind (and they are the views of the friends of mercury—not those of its enemies), it is not unreasonable that we should, at least, be cautious in the use of an agent so powerful. And with this view, it may again be asked, how small a quantity of any mercurial is capable of producing observable constitutional effects?

In Pereira's *Materia Medica*, vol. i. page 594, note, a case is described in which there was evidently a strong idiosyncrasy against the use of mercury. "A patient of Mr. G.'s, of the Borough, desired him never to give her any mercury, as that drug was a poison to her whole family, to which he, without arguing the point, at once



assented. In Mr. G.'s absence, the late Mr. C. was consulted as to some trifling disorder of the bowels, and, not knowing the peculiarity of his patient's constitution, prescribed two grains of calomel. The next morning the lady showed the prescription to Mr. C., saying that she was sure she had taken mercury, as she felt it in her mouth. In a few hours ptyalism ensued; in consequence of which she lost her teeth, her jaw exfoliated, and she ultimately, after a succession of ailments, died in about two years." According to Cullerier, six or eight grains of mercurial ointment have often sufficed to excite violent salivation. Usually, half the weight of this ointment is mercury. Of the black oxyd of mercury, the dose is from half a grain to two or three grains; and salivation is often readily produced by the administration of a few doses.

When calomel is administered as an alterative, the usual dose is from half a grain to a grain; and it is well known that observable constitutional effects often result from these doses. Pereira refers to the case of a lad, aged fourteen, "in whom six grains of calomel apparently produced inflammation and ulceration of the mouth, enormous swelling of the face, mercurial fetor of the breath, mortification, and death. There was no ptyalism." This is an *exact* description of a case that occurred in my own practice, in 1845, except that the patient was a *girl, aged twelve*.

The dose of chloride of mercury (corrosive sublimate) is from one-sixteenth to one-eighth of a grain; and if administered in quantities much greater than these, it is apt to gripe and purge.

From these observations and quotations, it would be readily inferred that at least some of the mercurial compounds are very active and powerful medicines or poisons, as the case may be. Indeed, we have seen many cases of severe salivation caused, respectively, by a single blue



pill of three grains. I know that such cases are regarded as exceptional; but they are so frequent that their claim to such regard is scarcely valid.

It is well known that mercury is but slightly vaporized at ordinary temperatures. Not only is the vapor formed small in quantity in proportion to the surface exposed, but, being nearly seven times as heavy as air, it rises but a small distance from the surface. If gold leaf is suspended over mercury, it will be whitened by amalgamation to the height that the vapor rises. The barometer-maker's danger is, therefore, mainly from contact with the skin, and not from inhalation. As this contact is not extensive, the mercury must be very slowly introduced into the system. Yet it is well known that his occupation is not a safe one. That a very slow and greatly prolonged introduction of this metal into the system is capable of producing injurious results, is a well-recognized fact among scientific men. Dr. Scheele reports "a fatal case, attended with salivation, brought on from wearing at the breast, during six years, a leathern bag containing a few drachms of liquid mercury."

But this is the "amalgam," not the *mercurial* question; and we therefore proceed to inquire, in view of all the facts known to science, whether or not it is at all reasonable that mercurialization should result from amalgam fillings in the teeth.

Amalgam plugs are usually large, as none but quacks insert them in small cavities. We have weighed some freshly inserted, and many that were considerably corroded, and have found a number weighing over forty grains each. Many are much smaller. We have frequently seen two, three, or four large ones in the same mouth; and in one mouth we saw *seventeen*, large and small. But, for illustration, let us suppose a case in which eighty grains of amalgam cement are inserted. This is not an



extraordinary case. Four molars, with a small plug each, would give the amount. If the silver amalgam is used, about one-half the weight is mercury. If the silver and tin, the proportion of mercury is not quite so great. For convenience of calculation, let us take the former.

The forty grains of mercury (even though inert in the metallic state, which is not yet proved, however) would make two drachms of blue mass, or forty officinal blue pills. They would make about fifty-four grains of corrosive sublimate. They would yield forty-seven grains of calomel, or nearly forty-two grains of black oxyd of mercury.

Now, no scientific man could be surprised at witnessing constitutional effects from the presence of such quantities of any one of these drugs.

But the amalgam advocates may, and do object that these compounds are not liable to be formed in the mouth; but, with the next breath, they go on to lament the "blackness," "discoloration," "coloration," etc., through all the changes, ascribing it all the while to *oxydation*, thus acknowledging that the last-named drug is almost invariably formed. And it is objected, too, that if formed at all, these drugs are formed, and therefore introduced so slowly and gradually that they can produce no perceptible effects. But such objectors manifest an ignorance of scientific truth hardly excusable in this enlightened age of the profession. The slow and gradual introduction is the important point to be considered. It is here that the danger lies. When rapidly introduced, the system is aroused and rebels, and much of the poison is ejected. This slow introduction is nothing else than "nurturing up wrath against the day of wrath," as in the case of the man that wore the metal in a leathern bag. The poison could only pass infinitesimally into his system; yet in six years it did its work. And those who wear amalgam plugs in



their mouths for six years, and especially for "fifteen years," have no security that their fates will not be similar. Indeed, many cases occur in which there is severe mercurial disease, while neither physician nor patient suspects the cause. The physician is deceived by the patient's assertion that he has taken no mercurials, or perhaps no medicines of any kind. Many cases that pass for "spontaneous salivation" are the legitimate result of the presence of amalgam plugs in the mouth. A case of "shaking palsy" occurred in our practice in 1850, which resisted treatment for two months, growing worse all the time, and which recovered promptly, without further treatment, after removing several amalgam plugs from the teeth. And we must be excused if, when we read of old practitioners, whose neighbors, as well as themselves, have been all along using amalgams, and who yet assert that they have never seen a case of ptyalism or other constitutional disease arising from their use—we must be excused if we look upon them "with considerable doubt as to the value of their judgment or opinions as reliable diagnosticians."

It would be amusing, were the case not serious, to witness the varied positions, and the arguments to sustain these positions, resorted to by those who deny the fact of mercurial poisoning by amalgam plugs.

One believes the "profession had never heard of but *one* practitioner who *thought* that the result (ptyalism) was produced by amalgam." But this only proves that he has not listened through the ears of the profession, perhaps not even with professional ears.

Another cannot believe that amalgam fillings can produce ptyalism, because this is produced through the general system, whether the mercury is used externally or internally. Now it is not probable that any one believes



that amalgam plugs can produce ptyalism by mere local action.

Another is a disbeliever because "it is well known that mercury uncombined is inert"—which is merely an assertion, and because "equally so must it be when combined with silver or tin,"—which is a mere assumption. And he is further confirmed in his position from the fact that "the protochloride of mercury (calomel) and deutechloride of mercury (corrosive sublimate) are formed from sulphate of mercury and muriate of soda, triturated and sublimated. As this process cannot very well be carried on in the mouth, it is hardly supposable that they are elaborated to any extent." Well, there is chemistry for you ; but it is

"Science distorted and torn into bits,  
And tortured and frightened half out of her wits."

Are we to infer that chlorine and mercury can combine only under the circumstances here detailed ?

It is rather surprising, and quite mortifying to witness the lack of knowledge manifested by many of the profession in regard to the obvious and ordinary constitutional effects of mercury. When it is objected to the use of amalgams that there is danger of mercurial poisoning, the answer is that abscess, exostosis, and necrosis occur in mouths where no mercury is used, as if these were what is meant by *constitutional* effects of mercury. And where a genuine case of poisoning is presented, it is referred to some other cause than mercury, because "many cases of irritated gums looking terribly enough had yielded to proper constitutional and local treatment," as if irritated gums were all of ptyalism, and as if acute ptyalism were not amenable to treatment. Any scientific dentist would infer that there is greater danger of mercurialization from this source when the fluids of the mouth



are acid than when they are alkaline. If a case of ptyalism presented itself, and the amalgam plugs were allowed to remain, a part of the proper treatment would be to secure an alkaline state of the saliva. And he would infer that the disease was most likely the result of either the oxydation or chloridation of mercury; and as its compounds with sulphur are far less poisonous than its oxyds or chlorides, and are nearly insoluble, he would take such measures as would secure its sulphidation. We make these remarks merely to remind the reader that even ptyalism is amenable to proper constitutional treatment; and hence, yielding to treatment is no evidence that the disease is not ptyalism. If the corrosion of the mercury is stopped for the time, the disease will usually exhaust itself, and recovery will take place without direct treatment.

One disbeliever suggests that many of the cases taken for the effects of mercury are the result of "mechanical irritation—which would have resulted just as soon from an equally bad gold plug." Now every one who understands the subject knows that *mechanical* irritation never did and never will produce results very much like mercurial ptyalism.

It is well known that ptyalism may be and is produced by other causes than mercury. There is what is called "spontaneous ptyalism." And it is cordially admitted that in a large majority of cases, in which amalgams are used, no observable constitutional effects result. But it will not do, on this account, to deny the fact of mercurial poisoning by amalgam plugs. The same warrant is afforded for the denial of mercurialization from any source. In a large majority of cases in which mercurials are administered, no poisoning is observable. Indeed, it would be no more than consistent for some of our disbelieving brethren to write an article to prove that both mercury and its compounds are inert. They would be at



no loss for arguments stronger than those they are in the habit of using in discussing the "amalgam question." Why, a patient has taken over fifty drachms of calomel in less than as many hours "without the least sensible effect!" Take the position, and *stick to it*, that calomel never produces ptyalism. And if it should occur while the patient is taking the drug, be firm and *consistent*, by claiming that it was about to occur any way, and has resulted simply from "mechanical irritation."

All are familiar with the fact that amalgam plugs in the teeth are frequently blackened, but many seem never to inquire why. They are content to ascribe the blackness to oxydation. That the discoloration is superficial affords them real gratification.

Bearing in mind that *mercury* is a constituent of all *amalgams*, it may be profitable to inquire a little into the cause or causes of the discoloration referred to, and to notice some of the probable consequences of it.

Mercury is ordinarily a white metal, and we are aware of no process by which its color can be very materially changed. In this respect it differs greatly from gold, which can be made to assume any hue, from its own "golden yellow" to a jet black. It is evident, then, that the discoloration of an amalgam plug is not due to a change in the mechanical arrangement of the particles of the mercury. We are therefore to conclude that the blackness results from the combination of some other element or elements with the mercury, or that the mercury has nothing to do with the discoloration.

It should be borne in mind that the most popular dental amalgam contains tin and silver, both of which, as well as mercury, are characterized by strong affinities for some of the non-metallic elements liable to be brought in contact with them. The inquiry must therefore have reference to these as well as to the mercury.



Oxygen, sulphur, and chlorine are the elements most important to be considered, in this connection, with reference to their affinities for these metals.

The question is, what chemical compound or compounds cause the blackness? If a single compound, it is evidently insoluble in the fluids of the mouth; for however black, if soluble, it could only blacken the saliva, not the plug.

Is the black substance a chloride, then? Let us consider. It cannot be chloride of tin; for both of its chlorides are soluble. Nor can it be chloride of silver; for, though insoluble, it is white or grayish. And it is not chloride of mercury, for it is soluble; nor the subchloride, for it is white.

Is it an oxyd? Well, not an oxyd of tin, certainly, as the color determines; but both the oxyds of silver and the suboxyd of mercury are black.

Is it a sulphuret? The sulphuret of silver and the protosulphurets of tin and mercury are all black, or nearly so.

We may conclude, then, to discard chlorine as an agent in the blackening process.

Both sulphur and oxygen are capable of acting on any or all three of the metals under consideration, when the circumstances are favorable. Warmth, moisture, completeness of contact, concentration or rather condensation of the elements, and their nascent condition, may be regarded as some of the circumstances likely to promote the action of these elements on the metals under consideration.

The first three of these conditions are always present in the mouth, the liquidity of the saliva bringing itself and the substances dissolved in it into the most intimate contact with any solids retained in the mouth. The fourth condition is afforded with respect to oxygen, as the saliva



absorbs, and thereby concentrates this element. And as to the last-named modifying circumstance mentioned, that is, the nascent state, the action of both oxygen and sulphur are modified by it in many cases. Hydrosulphuric acid (sulphuretted hydrogen) is very frequently if not usually present in the mouth. It is often exhaled by the breath, and, being soluble in water, it of course is dissolved to some extent in the saliva. It is readily decomposed, especially when in contact with substances having an affinity for either one of its elements. As it is decomposed, its sulphur, with all the energy incident to the nascent state, unites with the metals under consideration. And this action is modified by the relative strength of its affinity for the three metals, and by the ratio of their equivalents. If the three affinities were equal, the sulphur would unite with the metals in the proportions of tin, 58; mercury, 101; and silver, 108. But mercury and silver have a stronger affinity for sulphur than tin has, and therefore the force of the sulphur is mainly spent on the former two metals. We would conclude, then, that much of the blackness is due to the formation of sulphurets of silver and mercury.

But all this time the oxygen concentrated in the saliva is not idle. In regard to its affinities, it will be sufficiently accurate for present purposes to apply the remarks already made in regard to sulphur. Its energies, too, are mainly spent on the silver and mercury. The suboxyds of these metals are more likely to be formed, under the circumstances, than the protoxyds; and as these are black, dark-colored amalgam plugs are not mysterious.

It may be well to remark, in this connection, that careful analysis fully confirms the conclusions here arrived at by a process of reasoning; and it might have been sufficient, for some, to have stated this at the outset; but we preferred the present course, as better calculated to im-



press the minds of our younger brethren, whom we regard as the hope of our profession.

Much has been said about galvanic action in the various discussions of the amalgam question, and it is plain that the subject is but little understood by many who talk about it. The dull boy in the grammar school, when puzzled about the classification of a word, contents himself with calling it an adverb; and in like manner, too many of us, when at a loss in regard to the nature of certain chemical actions, refer them to galvanic influence, and rest content. We have heard of galvanic currents vibrating back and forth along a gold clasp till, by their rapid and continued see-sawing, they had worn or cut away the tooth. We have listened to much that was but little farther removed from nonsense. Still, the question of galvanic action has its place, and is entitled to consideration. Indeed, it is probable that chemical affinity is only another name for galvanic or electric influence. Certain it is, however, that when two metals, in contact with each other, are placed in a liquid which acts on but one of them, or unequally on both, a galvanic current is established. The force of this current is modified by the degree of energy of the chemical action, by the extent of surface acted on or excited, and by the distance of the excited surfaces from each other. There are other modifying circumstances not important to be noticed here.

Bearing these points in mind, let us apply them to amalgam plugs in the mouth.

We have seen that the constituents of the saliva act with unequal energy on the metals considered; and, as they are in the saliva and in contact, it follows that galvanic action must ensue. And if there is such action at all in this case, it must result in the formation of an almost infinite series of minute circles, similar to those formed by immersing commercial zinc in a dilute acid. And as the



decomposing power of galvanic circles varies inversely as the square root of the distance between the excited surfaces, actual or apparent contact gives a battery of great power. And it should be borne in mind that the exciting solution of a galvanic battery is itself decomposed, or rather some binary compound in it must undergo decomposition. The saliva, then, acting on one of these metals, or unequally on more than one of them, galvanic action is established; and this being so, it follows that some binary compound of the saliva is decomposed. And if the currents have sufficient force, all its binary compounds will be thus decomposed. Water, hydrosulphuric acid, and the soluble chlorides would thus readily undergo decomposition. It follows from this, that the formation of the oxyds and sulphurets referred to above, is promoted by the galvanic action thus established.

But even to this there is a limit. The oxyds and sulphurets thus formed being nearly insoluble in ordinary saliva, and being deposited on the surfaces of the metals, protect the latter from the action of the former; and thus by arresting to a good degree the chemical, arrest with it the galvanic action. This will be better understood by a brief consideration of the ordinary zinc and copper battery. A sheet of zinc and one of copper, connected by a wire, if plunged into water, immediately establish a galvanic current. But this current is soon arrested; for the oxyd of zinc formed on the surface of the zinc plate is insoluble in the water, and therefore the metal is protected from further action. But if a little sulphuric acid be added to the water, it dissolves the oxyd as fast as formed, and the zinc continues to decompose the water, and the galvanic current is kept up.

It is only on account of this insolubility of the black oxyd and sulphuret of mercury, thus formed, that we see so few cases of the constitutional effects of the metal re-



sulting from amalgam fillings; for if they were as soluble as the chloride, a single plug of ordinary size could scarcely fail to produce these effects. If this position be correct, it follows that if it is proper at all to use amalgam fillings, it is no cause for discouragement to see them turn black. On the other hand, it is rather fortunate that they do blacken. And this corresponds exactly with our own observation on the subject, which has been *very extensive*, and embraces a period of more than a dozen years.\* We do not now recollect a single case of constitutional disturbance resulting from the presence of amalgam fillings in which the blackening of the plugs was very decided; and in the last three cases that we observed there was none at all.

Genuine chemical combination takes place in the formation of amalgams. This is evidenced by various phenomena that may be observed. When an attempt is made to combine two metals, differing considerably in their affinities for non-metallic elements, one of them, as soon as contact is made, necessarily becomes positive, and the other negative. For example, in making an amalgam of gold, the mercury is rendered positive, and its affinity for oxygen, a highly electro-negative element, is thereby greatly increased. The consequence is that the black oxyd of mercury is abundantly formed. The same thing takes place, though to a less extent, in making amalgams of tin and silver. We have met with many who regard the presence of this black oxyd as an evidence that the mercury is not pure. It is formed, however, when the metals are all pure. If this oxyd is put into a tooth cavity, along with the amalgam, of course the plug will not make as good an appearance as when it is removed by washing with alcohol, water, or a solution of common

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\* More than twenty now.



salt. And when the oxyd is thus washed away there is less danger of constitutional disturbance than when it is allowed to remain; for, in most mouths, after the amalgam is inserted, the sulphuret of mercury will be formed in greater abundance than the oxyd, and it is well known that the latter is a more active poison than the former. And besides its greater activity, in contact with hydrochloric acid, which is presented in many mouths, it is readily decomposed, the reaction yielding water and the subchloride of mercury or calomel. It is well known that calomel is a still more active preparation of mercury than the suboxyd.

But, as the fluids of the mouth cannot act unequally on the metals under consideration without exciting galvanic action, it will be understood by all who remember the presence of soluble chlorides in the saliva, that the formation of the subchloride, or even the chloride of mercury, is not improbable. The chlorides of sodium and potassium being binary compounds, and soluble, are readily decomposed by galvanic action. The chlorine, thus liberated, will unite with the mercury, just as the liberated oxygen unites with the zinc of the ordinary battery. As these chlorides are present in normal saliva, there is nothing remarkable in the formation of chloride of mercury from amalgam plugs; and it is probable that in all cases of constitutional effects arising from their presence, either the subchloride or the chloride is the agent that produces them. Were it not that the breaths of most patients, as well as their saliva, are loaded with hydrosulphuric acid, so that the insoluble black sulphuret is formed, the formation of at least one of the chlorides of mercury could scarcely be prevented.

Although the fact of metallic poisoning is as well established as any other, yet all classes incline to disbelieve it to the extent of their own personal interest in its truth.



The painter believes that the oxyds and salts of lead are poisonous, and that many of his craft are injured by them ; but he does not believe that he is in any danger. He regards himself as cautious and cleanly, and, therefore, safe. He may believe that his comrades are poisoned, but he is not. He is only a little nervous, and is rather costive, or has eaten something indigestible, and has colic. The margins of his gums are bluish ; but that is because his blood circulates badly. He has seen many such cases ; and to prove that lead has “nothing to do with the trouble existing,” he keeps right on at his business. The printer believes that both lead and antimony are poisonous ; but he handles the types with a thorough conviction that they will not poison him. When he becomes nervous and pale, he thinks it *possible* that *confinement* disagrees with him ; and, though his pallor is not like that of other pale men, he imagines that printer’s ink may cause the difference. Gilders, miners, and even chemists, practically incredulous while theoretically believing, often reason in the same way, and it is not, therefore, marvelous that our brethren of the —— Association are practically incredulous in regard to the poisonous effects of mercury and silver. This is one way by which they manifest their humanity. “Ye shall not surely die” was a popular doctrine as far back as the days of Mother Eve’s horticultural experience.

On the evening of April 9th, 1861, as we learn by the May number of the *Dental Cosmos*, the President of the Association announced “Amalgam” as the subject for discussion. Dr. —— opens cautiously, manifesting a desire to speak favorably of the article under consideration, but seems fearful of misrepresentation by those who “are constantly attributing results to it that are due, not to the amalgam, but to its improper use,” and “those who, unable to perform a successful operation with gold, are eager



to seize upon any remark in favor of a plastic material as an apology for their own empirical conduct." This last is certainly worthy of consideration; for all quackdom shouts at the very thoughts of the May number of the *Dental Cosmos*. It matters not to the quack that the said number contains much valuable matter. It contains an indorsement of his pet paste by the —— Association of Dental Surgeons. That is glory enough for him; and he drinks in consolation accordingly.

The report, as a whole, is an interesting specimen of special pleading in behalf of the material under consideration—

“Only this, and nothing more,”—

yet it is amusing to see how little these brethren can find to say in its favor, and how little they really think of it, notwithstanding their eulogies.

A frontier preacher conducting the funeral services of a notorious outlaw, politeness and truth being both desirable, was at a loss what to say. “My friends,” said he, “our deceased brother, like all things earthly, was perhaps not just all that he should have been. It is true he had horses, and he ran ’em. He had cocks, and he fit ’em. He had cards, and he played ’em. But, after all, he was a very good man at a fire; and no man in these diggins ever cheated him in a hoss-trade.” About such, when sifted, is the praise bestowed by our brethren on amalgam.

Dr. —— uses it “*sparingly*.” Dr. —— has a hopeless prejudice against its use. Early prejudices have led Dr. —— “to look with considerable suspicion upon amalgam as being, in any sense, a proper material for filling all classes of teeth.” Dr. —— once had a severe attack of “the prevailing prejudice” against it, but has quite recovered. In six years he has seen amalgam plugs “in many hundred mouths,” which proves that vice seen too oft, if not pitied, is at last embraced. Dr. —— never



was "imbued with any prejudices against" it. He escaped the disease entirely; and that, too, it seems, without vaccination.

It appears that none of these brethren use amalgam indiscriminately. Dr. — under no circumstances would use it in the front teeth, "believing that the preservation of their beauty is as essential as subserving the purpose of nutrition;" and he tells us that "in the largest proportion of teeth that are filled with it, their good appearance is completely sacrificed." Dr. — uses it only "in certain cases;" but the report fails to tell us why he repudiates it in *uncertain* ones. Dr. — would use it only in "teeth which it would be impossible to fill with gold foil, and yet too valuable to sacrifice." He would not use it in all, because he cannot "entirely free himself from such prejudice so as to use it indiscriminately," and because "it not only required more skill, but also afforded one more satisfaction to introduce a good gold filling; and such practice was by far better calculated to enable one to establish a high reputation as an operator." These reasons are no doubt good and valid in the present case; but if any operator is already freed from "such prejudice," and his reputation is as high as is desirable, he may, possibly, find as much satisfaction in using amalgam indiscriminately as in introducing good gold fillings; and if it is important that he should exercise skill for the mere sake of skill, he can spend the time gained by such indiscriminate use in stuffing butter into a gimlet hole "with a hot awl." When prejudice restricts the use of anything so valuable as amalgam appears to be in the — Association, it should be laid aside.

Dr. — seldom uses amalgam, "and then never in any but molar teeth very much decayed." Now, why, Dr. —? Do tell us. Dr. — claims that it can be



readily adapted to the walls of the cavity so as “to *exclude* all foreign destructive agencies”—that the objectionable discoloration is probably due to “the impurity of the materials, or to the presence of their oxyds, or the manner of their combination.” He infers all this from the fact that he finds “no free or combined acids” in the mouth capable of acting “to any extent upon pure mercury or silver.” Indeed! But does Dr. ——— not know that oxygen and sulphur, both found in the mouth, act directly on both these metals without the intervention of an acid? Moreover, he tells us that the mercury of commerce is “quite impure, and the silver usually very much oxydized at the time of using.” Well, really! The secretions of the mouth cannot act on the silver, but something (in the atmosphere, perhaps) oxydizes it so readily that oxydized silver is generally used in preparing amalgam! And, again, he tells us that “coloration may be due to galvanic action, induced by the saline secretions of the mouth, in the oxydation of one of the baser metals.” Tell us, Dr. ———, which two of the metals are *baser*, and then we will know which *one* is base? And tell us, too, how to arrest the galvanic action, when there are “saline secretions” in the mouth, before it has time to produce coloration? And tell us what kind of people and in what kind of weather they do not have “saline secretions in the mouth?”

Dr. ——— uses amalgam whenever he thinks it “necessary.” Good! for him. He can pass; for that is the way we do. But we have never used it yet.

Dr. ——— “does not use amalgam *from choice*, in any teeth except molars.” And we protest that it is very wicked for anybody to *compel* him to use it in any others. He used to have two objections to its use; but by the help of Dr. ——— and *some salt*, “he had been able, in a great measure, to do away with” one of them. The remaining



one is "the failure to preserve the teeth in plugging certain cavities;" which is rather a serious objection, and one beyond the reach of salt, we fear. Dr. ——— finds that amalgam fillings on the proximal surfaces of teeth fail "in a comparatively short time," while upon the articulating faces of molar teeth they do "better service than anything except the very best gold plugs, and equaling even these, as far as six years' proving could testify." And in comparing amalgam with gold for filling such cavities, especially when large, "he thought the argument was decidedly in favor of amalgam; for while it saved teeth as permanently as the very best gold plugs, it was introduced with much less of disagreeable manipulation, less irritation, less consumption of time, less expense, and was so nearly the color of the tooth as to be scarcely noticeable." Now, if these claims are all well founded, gold should be abandoned; for if amalgam is as good as gold in large cavities, it is better in small ones; and if decidedly preferable on articulating surfaces, it is certainly as good in proximal cavities; for it is as much exposed to chemical action in the one place as in the other. And if it is so nearly the color of the tooth as to be scarcely noticeable, it is the very thing for front teeth, and should by no means be restricted to molars. And if it is so reliable that in six years it is affected just none at all by chemical action, in twelve years it will be affected only twice as much, which will not be serious. We protest that the friends of amalgam treat it shabbily. Come, now! Give it a fair chance. If it saves the frail teeth with the large cavities—if it saves the unfavorable cases as well as gold does the favorable ones—what wouldn't it do in firm teeth with small cavities? It would heal up the holes and enamel them in less than a week.

But the discoloration—that's the bugbear—the hobgoblin that haunts the imaginations of our friends of the



—— Association. We are all superstitious—are the worst frightened at that which is the most mysterious. And our friends (most of them, at least) appear to be in a quandary as to the causes of the discoloration, and are therefore more concerned about the looks of a tooth than the health of a patient. Dr. —— comes to the rescue, however, and the ghost is laid. He removes and prevents the discoloration by triturating the amalgam with common salt, and afterward washing it. “Salt is good.” Blessed be the man that invented it! But, poor man, he didn’t know it all. He knew how to “save his bacon;” but our friend can keep a nastier thing than swine’s flesh from spoiling. May his countenance be perpetuated in marble.

But we ought to be serious over this salt-and-water process, and would be, if it amounted to anything more than a mere removal of the oxyd necessarily formed during combination, which can be accomplished as effectually, and almost as readily, with water or alcohol.

These brethren of the —— Association use, substantially, the preparation called “Townsend’s Amalgam;” though just why it is called *Townsend’s* is hard to divine, since Dr. T. set up no claim to originality in regard to its preparation, but obtained the formula, we are sorry to say, in the West. But there is a funnier thing than this. Why did not Dr. Townsend obtain as satisfactory results with this amalgam as these brethren report, when he prepared and introduced it as carefully and perfectly as any can claim to do now? Why did he obtain such results that he found it necessary to make a public recantation of almost everything he claimed for it? Was he entirely mistaken about it when he said that in cases where he most relied upon it, and expected to have the best results, it entirely failed? And why should not these brethren who so blindly followed Dr. T. when he went astray, fol-



low him back when he so promptly and manfully returned to the paths of scientific truth? We protest that if the sheep do jump into the sea because their blinded bell-wether falls over the cliffs, if he bravely swims out and returns to the pasture, they ought to follow him.

Amalgam cement used to be made of mercury and silver. Various other metals were recommended as ingredients. The old silver amalgam long since had become very unpopular. It was regarded as a *black spot* on our professional escutcheon. And what is this that is to be dubbed respectable? Is either of these base metals of the old formula discarded? Not at all. They are simply rendered respectable and perfect by the addition of *another base metal!* An ox-driver who fancied his team was not just the ton, hitched a mule in front of them, and concluded all was right; but he found his cart was still a *slow coach*. So these brethren, not satisfied with silver and mercury, add *tin*; but they find the hated black spot still there.

Dr. ——— tells us—or rather the report tells us—that the doctor “remarked that the discoloration of amalgam was superficial, and that it was oftentimes possible to restore the beauty of a tooth by simply removing the amalgam plug and excavating the darkened portion of dentine.” That might answer sometimes, and is worthy of attention. The idea has quite a range of application. If the entire tooth becomes discolored, pull it out,—if the entire head, cut it off; and if the patient’s complexion becomes darkened by the oxyd of silver, the discoloration, being “superficial,” can be removed by “simply” skinning him.

This paper is already too long. We will, therefore, close; and if in the mood, we will at another time say something in regard to the causes of discoloration, so an-



noying to our friends, and perhaps notice some of their answers to objections made against the use of amalgam cements. We look upon this report as calculated to becloud and lead astray the minds of the more youthful in our profession, and this is our only apology for bestowing on it so much more attention than it really merits.



## “ARGENTINE”! (?)

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“Monsieur Tonson’s come again!”

ACCORDING to Garrick, one item in the direction given by Jupiter to his attendants, when about to make Goldsmith, was,

“Set fire to the head and set fire to the tail.”

Fortunately, the “M.” editor of the *American Review* has adopted this principle in the illumination of an article in his November number. The article is about “ARGENTINE,” whatever that is. By the headlight of the article we are able to read “Gold versus Amalgam,” and by its caudal phosphorescence we are able to discern a very ordinary method of preparing “amalgam paste,” from which we infer that “argentine” is the rotten carcass of “amalgam cement,” long since buried “with the burial of an ass” by the better informed of the profession, but now resurrected and *nom de plumé* by this editor of the *Review*. “Argentine,” indeed! We have heard of a kind-hearted man who never calls a certain long-eared animal a mule, lest the name might suggest that he is the son of a jackass. He calls him a *horseine*.

But seriously, we are surprised at M.’s article, and we are surprised at the man. He gives a case in which two bicuspid teeth were filled—one with gold, the other with amalgam cement. By means of clasps and a plate the two plugs were electrically connected by a perfect metallic



conductor. After a lapse of two years or more, the tooth filled with gold is found decayed around the plug, while the other remains sound. Now, while this is exactly what science would look for, under the circumstances, and while it affords one of the strongest arguments against the use of amalgams, our friend goes on to dignify them with a high-sounding name, and to defend the use of them, in view of this case. His opinion is that the main reason for the "seeming superiority" of amalgam over gold is that it "exerts a chemical as well as mechanical influence to arrest caries. Well, what kind of chemical influence does it exert? Dental caries is produced by acids. Is amalgam cement alkaline? In this paragraph he claims for the amalgam only a "*seeming* superiority" over gold, and tells us that when properly prepared, it "*is, perhaps,* more certain than gold to stay the ravages of decay" in soft, badly organized teeth. (The italics are ours.) He seems, however, to be frightened at such a claim (and well he might be), and goes on to state clearly his views, "for fear that some young and inexperienced practitioner may be misled by the foregoing remarks," and conclude that he advocates the indiscriminate use of amalgams. These views are so clearly stated, and are so interesting in themselves, that we will reproduce them. He says, on page 189:

"In the first place, we admit that many failures have been, and are constantly being made, with amalgam, as a filling for teeth; but we deny, at the same time, that the percentage of failures is greater in this than gold work. And we believe, furthermore, that if the same care in preparing the cavity and the regard to nice manipulation were manifested in filling with argentine that there is with gold, the percentum of success would be larger with the former than the latter. And, again, were we to use



it in just such cases as we use gold, *i.e.* in the most favorable cases, the proportion of successful operations would be still greatly augmented. But who that can fill a tooth *well* with gold will resort to anything else, in a case where he feels that he can do such a job as will benefit his patient, and do himself and profession credit?

“Could every one who calls himself a dentist do good filling with gold, and were our patients so well aware of the necessity of seeing their dentist early and frequent, then, indeed, would the necessity rarely exist for the employment of anything but pure gold foil. But while the great majority of dentists do not know how, or lack the ability to fill teeth well with gold, and patients neglect their teeth, and refrain from calling on the dentist until their teeth are in an advanced stage of caries, argentine must hold a prominent place in dental therapeutics.”

Now, let us look at this. He claims that amalgam filling, as it has been, and is practiced, is *as successful* as gold filling. He claims, further, that if the two styles of work were performed with equal care, amalgam filling would be *more successful* than gold. And, besides, it is used only in unfavorable cases. If used in the favorable cases, as gold is, it would still be *far more successful*. In short, it is as successful as gold, now. If used with care it would be more successful. And, if used with care, and in favorable cases, it would be much more so. And this, dear reader, is the doctrine he has stated so “clearly,” for fear that some “young and inexperienced practitioner” will conclude that he advocates the “indiscriminate use of argentine.” Now, “young and inexperienced practitioners,” don’t use amalgam cement “indiscriminately,” or, if you do, be sure to call it “ARGENTINE.” To be sure, it saves unfavorable cases, even when carelessly used, just



as well as gold, carefully used, saves favorable cases. But don't you use it "indiscriminately."

We stated that we are surprised at M.'s article, and at the man. At the article for the sentiments it contains, and at the man for holding these sentiments, while he objects to their reduction to practice. What! shall we not use this "argentine" right straight along, when the success of even those "that can fill a tooth *well* with gold" will be augmented?



## SMELLS, AND THEIR MANAGEMENT.

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WHEN a certain Spartan woman visited a lady friend, we are told by Plutarch that one of them was so thoroughly perfumed with "sweet ointment," and the other with *butter*, that they were not able to endure each other's presence. The *sweet* ointment is of doubtful composition; but she that objected to the butter had substantial reasons for her disgust, as, when used as an ointment, on account of the great extent of surface exposed, it would decompose rapidly, and, by the formation of butyric acid, a genuine *stink* would be produced.

In these days of perfumes and cosmetics, there is at least some danger that similar mutual disgust may be engendered between the dentist and his patients. True, the dentist, for sake of patronage, is expected to endure the hardship of stinks without a murmur; and in this manner he should endure all that are unavoidable. But when a little common sense and practical knowledge will do much to overcome such difficulties, justice to the olfactory nerves requires a proper application of this sense and knowledge. And a decent regard for the comfort of his patients, in connection with a due appreciation of his own interests, would lead him to give close attention to the prevention of unpleasant odors, both about his person and office. And, as tastes are so varied that it is impossible to tell what odors any given individual would enjoy, good sense would teach him, when at all possible, to guard against the presence of any odor whatever. *Odorless perfumes,*



in the language of the "green Isle," will meet with fewest objectors.

While it is true that people differ widely in regard to their choice of odors, yet there are some smells that are almost unanimously regarded as unpleasant. Some of these are natural productions; others are formed by art. A few only will be noticed in this connection.

**Hydrosulphuric Acid.**—This acid, often called *sulphuretted* hydrogen, occurs abundantly in nature, and is readily formed by art. If iron filings and sulphur are heated together in a crucible, in the proportion of 28 parts of iron to 16 of sulphur, they combine, forming a black substance called *sulphuret of iron*. When sulphuric acid is poured on this a gas is given off, having a strong offensive smell like that of rotten eggs. This gas is not only offensive, but highly poisonous when inspired. Water dissolves about two and a half times its bulk of it, which is again expelled when the water is boiled.

A person who indulges in the excessive use of albuminous food, or otherwise introduces sulphur into his system, exhales this acid both by expiration and through the pores of the skin. Every dentist who has an experience at the chair has found patients whose breaths were loaded with this fetid gas; and he has found himself far more relaxed and exhausted after operating for such a patient, than after waiting on one whose breath was normal. It is not often practicable to rectify the patient's breath before operating, though in a few cases we do it; but, from the effects of the patient's breath on himself, the dentist should learn a lesson in regard to the possible effect of his on the patient. And a little carelessness in this respect may lose him the patronage of many valuable, though sensitive patients.

This gas is also formed in the mouth when albuminous matters are allowed to putrefy or decompose in it; and,



being soluble in water, the saliva from this source, as well as from the breath, is often found highly impregnated with it. Its oxydation here is the probable origin of the sulphuric acid which produces the black variety of dental caries. When the saliva contains it, it throws down a black precipitate (*sulphuret of lead*) from a solution of acetate of lead. This test is sufficiently reliable for the dental office.

This gas is a principal cause of the inordinate stench arising from the putrefaction of dead carcasses, or of animal matters generally. Hence, the dentist needs not be told that if *blood* be allowed to decompose in or about his spittoon, he must expect to meet with it. And here it may be well enough to remark that too great care cannot be exercised, either about the person or office of the operator; for a smell that would be highly offensive to a sensitive patient might not be observed at all by him, as by its gradual manifestation his senses may have been taught to tolerate it.

**Phosphuretted Hydrogen** is another offensive gas, formed in the putrefaction of animal matter; and many of the general remarks on the sulphuretted hydrogen are equally applicable to this.

**Ammonia** is also formed and given off under similar circumstances; and, commingled with the two gases above considered, forms one of the most loathsome stench known in nature.

The sweat contains a number of odorous principles, none of them very agreeable under the circumstances in which they are presented, and some of them very highly offensive. Many strongly scented substances, when taken into the stomach, pass into the circulation and are exhaled with the perspiration. The odorous principles of garlic, onions, tobacco, etc. are familiar illustrations of this fact. But offensive odors seem to pertain to normal sweat, their



quantity and offensiveness varying greatly in different persons.

These odorous principles are not all thoroughly understood. It is pretty well established that butyric acid is ordinarily present, which is sufficiently offensive to disgust even those who are not fastidious. But this does not explain all; for the perspiration of the feet, axillæ, and groins is often, indeed generally, more fetid than that of other parts, while it usually gives an alkaline reaction.

The eating of onions and garlic, and the chewing or smoking of tobacco are often the means of introducing the most offensive smells into the dental office. When introduced by the patient, he should be charged double price for each operation performed; when by the operator, the patient should leave the office without hesitation or ceremony. It is no mitigation that ladies often politely *pretend* that these smells are not offensive. It is to be hoped that a kind Saviour will pardon their good-natured hypocrisy, and that His Holy Spirit will purify their hearts from it.

A frequent cause of a fetid breath is a morbid secretion of the tonsils and the parts in their vicinity. Of the composition of the odorous principle of this secretion we know but little. The sebaceous secretions, too, often become very offensive when cleanliness is neglected.

But we have no more space to devote to smells. The question arises as to their management. The agencies employed in this direction may be divided into *smell-preventers*, *smell-disguisers*, *smell-removers*, and *smell-destroyers*. Or they may be called *antiseptics*, *perfumes*, *deodorizers*, and *disinfectants*.

The ordinary processes of preserving meat are familiar proofs that offensive smells may be prevented. But about the dental office substances likely to produce them should be carefully removed before they have time to decompose.



It is not always practicable to have the spittoons so perfectly arranged that all traces of blood are instantly washed into a sink by a current of water. Hence the necessity of preventing its putrefaction, which, in hot weather, is very rapid. With the most careful removal, slight traces of blood often remain, and prove highly offensive to sensitive patients. The stench from this source is mostly due to sulphuretted and phosphuretted hydrogen, and ammonia. And their formation may be mainly or wholly prevented by the presence, in contact with the blood, of common salt, sugar, quicklime, nitrate of potash, sulphate of iron, or vegetable astringents.

But when the unpleasant odors are once formed, let them be *removed* or *destroyed*. They should never be *disguised*. It has been well remarked by Johnson that when we mingle with the smell which we dislike some odor we can enjoy, we "leave floating in the air around us the evil and the good together, to produce unheeded their natural effects upon the system." He says, further: "Sweet odors are thus the natural disguisers of evil smells. They are the only resource of rude and dirty times against the offensive emanations from decaying animal and vegetable substances, from undrained and untidy dwellings, from unclean clothes, from ill-washed skins, and from ill-used stomachs. The scented handkerchief in these circumstances takes the place of the sponge and shower-bath; the pastile hides the want of ventilation; the ottar of roses seems to render the scavenger unnecessary, and a sprinkling of musk sets all other stinks and smells at defiance."

Substances used for the *removal* of smells are called deodorizers; and it should be always remembered that cleanliness and ventilation are generally the great agencies, and though they may sometimes fail to accomplish all that is desirable, yet they are never inappropriate.

Charcoal has long held a prominent place among the

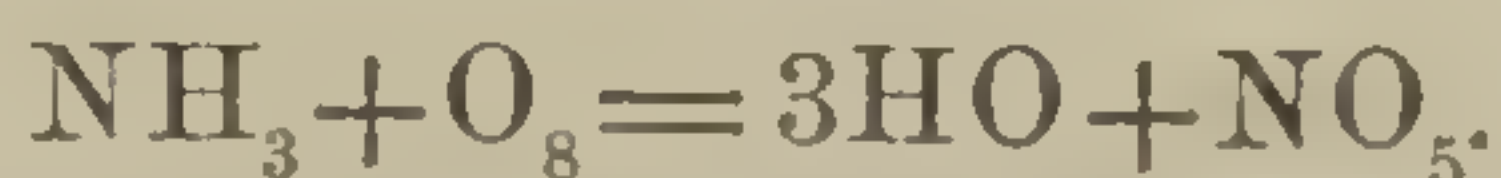


deodorizers. Like other porous bodies, it concentrates gases and vapors in its pores. From its great porosity, and from the fact that it suffers no chemical change in the process, it is very efficient in this respect. Freshly calcined, light wood-charcoal absorbs nearly 100 times its bulk of ammonia, 50 times its bulk of hydrosulphuric acid, nearly 10 of oxygen, and varying proportions of other gases.

While this condensing power of charcoal is due mainly, if not solely, to its *physical* property of porosity, yet active chemical changes are induced by it. For example, when various gases are thus condensed, they are brought within the range of their affinities—are *more intimately in contact* than in their ordinary diffused state. When sulphuretted hydrogen and oxygen (from the atmosphere) are thus in contact, the sulphur and hydrogen are both oxydized, forming sulphuric acid and water, as represented in the following formula:



Phosphuretted hydrogen is similarly oxydized under like circumstances, phosphoric acid and water being the result. Ammonia also suffers a like fate by the formation of *nitric acid* and water, the reaction being indicated thus:



The non-chemical reader will please understand that ammonia is composed of nitrogen and hydrogen, as represented by the symbols,  $\text{NH}_3$ .

Calcined clay, the ashes of bituminous coal, coke, and many other porous substances, have the same effect as charcoal, but in a less degree. But with the exception of what can be accomplished by cleanliness and ventilation, smell-removing is not as well adapted to the wants of the dental office as smell-destroying.

There is a radical and highly practical difference be-



tween *deodorizers* and *disinfectants*—between smell-removers and smell-destroyers. Water, as already referred to, may remove sulphuretted hydrogen from the atmosphere by dissolving it, but on the application of heat, or the gradual evaporation of the water, the gas escapes unchanged. But far different is the case when this, or a similar gas, is acted on by a *disinfectant*. The disinfectant either combines with it, forming a non-offensive compound, or it decomposes it.

It is not our purpose to notice all or even many of the substances relied on as disinfectants. A proper understanding of the few most convenient and most applicable to the wants of the dental office is far more desirable than indefinite ideas extended over a much wider range.

*Sulphurous acid* is a cheap and powerful disinfectant, but has many objectionable properties which nearly exclude it from the dental office. It is readily and rapidly formed by burning sulphur, or by immersing copper in sulphuric acid. By virtue of its acidity, it neutralizes alkaline substances; and of course, therefore, ammonia, one of the offensive results of animal putrefaction. Its great affinity for oxygen enables it to decompose most odorous compounds containing that element. But being itself highly offensive to the smell, and almost irrespirable, added to the fact that instruments of steel are rapidly corroded when exposed to its action, it is not adapted to the dental office, as such, but is very effectual, cheap, and convenient in purifying houses which have been neglected, provided the process is completed and the house ventilated before occupying it.

*Chlorine*, however, is quite as reliable, and in many cases more so than the sulphurous acid. It, too, indirectly corrodes our instruments, if left to come in contact with them; and it is a *very* suffocating gas, but is more manageable than that just considered. It may be obtained



very cheaply by mixing together common salt and black oxyd of manganese, and pouring sulphuric acid (oil of vitriol) over them. As all the materials are cheap, minute attention to proportions is not necessary. The action, too, is more satisfactory when the acid is somewhat diluted.

Chlorine is not only the great *bleaching agent*, but the great disinfectant. By virtue of its affinity for hydrogen, it readily decomposes sulphuretted hydrogen, phosphuretted hydrogen, and ammonia, as well as nearly all other odors arising from the putrefactive process. In the presence of moisture, it takes hydrogen from the water, leaving oxygen in its nascent state, to act with an energy but little if at all inferior to its own. Indirectly, it is thus the great *oxydizing agent*.

Chlorine is very efficient as a disinfectant, even when greatly diluted with atmospheric air and vapor of water. When thus highly diluted it may be breathed without either difficulty or danger, and sometimes, as in putrescent diseases, with advantage.

The *chloride of lime* of commerce, which is the hypochlorite of lime mixed with hydrate of lime, is more convenient in many cases than chlorine. When a solid or liquid disinfectant is desired, this is at once suggested. Its action is not as unlike that of chlorine as some have maintained. The lime which it contains, by its alkaline properties can neutralize, at least to a good degree, acid odors; but the hypochlorous acid is the great disinfectant principle of this compound. This acid, as stated in a former article (see "Calcium and its Compounds"), is not a permanent compound, but is readily decomposed; and thus the chlorine and oxygen, of which it is composed, are both presented in their nascent state to act on the odorous compound, whatever it may be.

Let us suppose, then, that this substance (the chloride



of lime) is brought in contact with blood, or other animal matter in the process of putrefaction, and consider the chemical actions which result.

Ammonia, phosphuretted hydrogen, and sulphuretted hydrogen all contain hydrogen as one of their constituent elements. Hypochlorous acid is composed of one equivalent of chlorine and one of oxygen. This acid will be rapidly decomposed in the circumstances under consideration. Its chlorine unites with the hydrogen of the three offensive compounds referred to, to form hydrochloric (muriatic) acid. The oxygen unites with the nitrogen of the ammonia and with the phosphorus and sulphur of the others, forming nitric, phosphoric, and sulphuric acids; and the lime combines with these acids, forming nitrate of lime, etc.

Of course it is not maintained that these reactions, and these only, can take place under the supposed circumstances; for the liberated oxygen may, in part, unite with hydrogen, forming water; but the disinfectant results would not be thereby compromised.

When the offensive odor is in the cavity of a tooth, or in the antrum, the *hypochlorite of soda* (*liquor sodæ chlorinatæ*) is more convenient than chloride of lime, as it is already in the liquid state. This is also a more pleasant application to the tonsils or fauces, and is better taken internally than the chloride of lime. When used internally or as a gargle, it should be diluted with pure water.

From the remarks already made, the careful reader will have but little difficulty in *managing* any smell with which his office is likely to be polluted or himself annoyed. He should never *give* occasion for attention to the odors of tobacco, garlic, or onions. If he cannot totally govern his appetites in these directions, he should control them as long as possible, then close his office, lay in a bountiful supply of the bulbous roots, have himself arrested, and



duly imprisoned in a tobacco warehouse, and there riot in the luxuries of his favorite stinks, while men more civilized wait on his patients.

A fetid perspiration is often a very serious annoyance to persons cleanly in their habits and attentive to their persons. To such we would hint that as the sweat usually gives an acid reaction, alkaline washes are suggested. The butyric acid of the perspiration is readily neutralized in this manner; and the carbonate of potash is as effective and convenient for thus washing as any other alkaline substance. But the offensive perspiration of the armpits, groins, and feet is often alkaline; in which case acids would be suggested. The feet are often very difficult to manage in this respect. Some have succeeded admirably by slightly moistening their hose with diluted acetic acid, of course not neglecting the most scrupulous cleanliness. But in extreme cases, the chloride of lime is the best resort. If the perspiration is acid, the lime is there to neutralize it. And whether acid or alkaline, but few odorous compounds are eliminated, either by secretion, excretion, or putrefaction, that oxygen and chlorine in their nascent state cannot decompose.

We intend this article to be practical. Many dentists, as well as others, are offensively odorous, either naturally or by art, without being conscious of it. Even the foul-mouthed tobacco-user, with the loathsome narcotic exhaling from every pore, regards his presence as not unpleasant. It is probable that the skunk, too, is blest with a like innocence; for we never hear of its forsaking its den on account of its own odor.



## PROFESSIONAL SIGNS AND ADVERTISEMENTS.

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WHILE it is necessary for the true professional man to avoid even the appearance of quackery, it is possible that he may do himself and the public injustice by mistaken notions or over-squeamishness on the subject of empiricism. Of course he must not advertise as the quack does; but it is not to be inferred from this that it savors of quackery for him to advertise at all. And if he has a right to advertise at all, he has a right to do so to whatever extent he may see proper. It is not the extent, but the kind of advertising that distinguishes the quack from the professional man. When a man has announced himself, in all the respectable advertising mediums of the land, as "JOHN JONES, DENTIST, Number 21 Fourth Street," he has done nothing inconsistent with the highest standard of professional honor; but he has manifested a degree of energy and enterprise that is likely to be duly rewarded. But if his announcement is, "Joy to the suffering!! The world-renowned Professor John Jones, P.T., P.P., is most happy to be able to announce to the afflicted world that he has returned to his native country, after long years of successful practice among the Royal Families of Africa ——," it is fair to conclude that the ponderous initials stand for *Professional Tinker* and *Pocket Picker*—in short, that the said John Jones is a quack.

The same general principle applies to office signs. The man who announces his name and business on a neat sign, and places it conspicuously before the public, is only doing



justice to himself and his patrons. What right has he to subject his friends to the humiliating necessity of going up and down the highways, inquiring of policemen or neighbors the way to his door? Our patrons seek us on account of their misfortunes and sufferings. Shall we force them to proclaim these, by their anxious inquiries for the dental office? It is not kind to do so. Nor is it modest. The man who does not signify his name and place of business says, as plainly as actions can say, that others may resort to such devices if they see fit; they perhaps need them. *I* have no occasion to resort to them; *my* reputation is such that the public will seek me out, or *my* pecuniary circumstances enable me to rest on my professional dignity till business finds me. And if these assumptions are true, no one can seriously object to his course; but for him to imagine himself the pink of modesty on account of it, is slightly objectionable.

During a ramble in a strange city, we came to a row of houses occupied by the several branches of the Bunker family. On the door-plates were J. Bunker, Thos. Bunker, Wm. Bunker, and BUNKER. Ah! thought I, that's where Bunker *himself* lives. If you have business with Jack, or Tom, or Bill Bunker, you can find him at home; but if you wish to see BUNKER HIMSELF, call at this door. It did not surprise me to learn, from a friend, that the last named was the only snob of the four brothers.

But, on the other hand, the man who sets forth himself and business by outlandish, barbarous signs, such as grinning skeletons, enormous images of monstrous teeth, or formidable pictures of more formidable forceps and cant-hooks, is a quack, and a very disgusting one at that.



## THEORO-PRACTICAL HINTS.

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THERE is nothing in this world more interesting than an unsatisfied soul. In such condition it is refreshing to watch its workings. We have acquired a periodical appetite for such refreshments, which usually receives its monthly gratification by reading "PRACTICAL HINTS" in the *Dental Cosmos*. There an earnest professional soul flounders beyond its depth, *unsatisfied* yet undismayed, hoping to touch bottom, and determined to reach the shore where the fountain of knowledge wells its bright waters from the depths of science.

Now it must never be inferred from this that our friend is beyond his depth when his "hints" are "*practical*," but when, in spite of their title, they become *theoretical*, then—

In the September number of the *Dental Cosmos* we are told that "in testing the mouths of different patients for many years with litmus and turmeric paper, to determine the character of their fluids, we have never yet discovered an alkaline reaction; on the contrary, always an acid."

This is *practical*, but differs from our own observations. But now for theory: "Using silver plates proves that there is a vast amount of acid exhaled from the blood through the lungs, differing in character in different individuals, but nevertheless destructive to the teeth when it is sufficient in quantity."

Now it would be interesting to know exactly how using silver plates proves all this.



All breaths contain carbonic acid. It is soluble in saliva. Many exhale hydrosulphuric acid, which is also soluble in saliva. It too is readily oxydized, its oxydation resulting in its decomposition and the formation of sulphuric acid and water. And if space would permit, we might continue to enumerate; but how does silver plate prove all this?

But we are told: "To correct this, when it becomes destructive to the teeth, systemic treatment may be useful, except in those constitutions which, from their own peculiar character, turn everything taken into the system into acid; such are commonly called acid temperaments."

The mild and the strong are certainly well mixed in that sentence. "*May* be useful!" Judicious systemic treatment *must* lessen the acidity of the secretions in such cases. The laws of chemical combination are *laws*—LAWS OF GOD, too, as really as the ten commandments are.

But if the patient proves to be one of those "acid temperaments," we must just give up. Feed him on beef-steak and eggs, and he turns them to aqua-fortis or oil of vitriol; give him bread, and he turns it into vinegar; stuff him with lime, inject him with soda, and soak him in pot-ash, and you only pickle him. He's a *sour fellow*.

But, come now, doctor, that wasn't a *practical* hint you gave us just then. But the reader of the *Dental Cosmos* has only to turn a leaf, and the "hints" there are *practical*; and we are sorry they are not more generally followed.

In the October number of the same periodical the subject is continued, with practical first and theory afterward. In the theoretical, after telling that decay doubtless results from the presence of acids, he remarks: "That the acid is always the same kind is not probably true," which is evidence that at least one unsatisfied soul is approaching its haven, for the same writer not long ago discoursed



as follows : "Some authors have labored to divide caries into several different kinds, but there is but one kind—the only difference is in the degree of intensity with which it makes its progress," etc.

Now we find recognized not only difference in degree, but difference in producing agents, and consequently more than one kind of caries.

But why is it now inferred that the acid is not always the same kind? It is stated that "we find that nearly all the fruits of the season, especially imported fruits which have become stale, destroy tooth-substance if kept for a time in contact with each other, and that many daily articles of diet will do the same."

This sentence is ambiguous, but we will try to understand it. Do these fruits, by contact with *each other*, develop electric currents? and do these currents decompose (by electrolysis) the surrounding fluids, so that acids result from the decomposition? Or, do they rot at the points of contact, and do acids result from this spontaneous decomposition? Or, does the author mean that these fruits "destroy tooth-substance if kept for a time in contact with" *it*? Possibly, but scarcely probable, or he would certainly have said so. But it is time for dental teachers to abandon the idea that the free acids contained in articles of diet directly induce dental caries, as the disease in its several varieties manifests itself; and it is highly gratifying to find this writer finishing his compound sentence thus: "But to suppose that it is imperative to abstain from all those things to insure immunity from dental caries is simply foolish."



## ALLOYS.

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THE term alloy, though once more limited, means a compound of any two or more metals. It is still a matter of dispute with some whether metals combine chemically, or whether their particles are mechanically mixed, in the formation of alloys. It is known to all that some unite much more readily than others. Gold and platinum, for example, unite far below the melting point of the latter, while silver and iron are combined with difficulty.

This subject, though somewhat neglected, is of great importance, as each alloy is, in reference to the arts and manufactures, a new metal, both on account of its physical and chemical properties. An extensive field here lies open. Only a few alloys have been studied by the chemist, and still fewer have been practically employed. Slight changes often constitute valuable improvements in these bodies, and there is no end to their modifications.

Metals do not unite with each other in the solid state. Assuming that alloys are chemical combinations, this is easily explained, their affinity being counteracted by the force of cohesion; and if they are mechanical mixtures the case is equally clear, for the ultimate parts of the metals must be separated to some extent in order to commingle. Two metals will, in some cases, combine when but one of them is liquefied, as when brass is formed by the immersion of copper in melted zinc.

Though metals appear to unite with each other in all proportions, yet it is probable that they tend to combine



in a definite ratio, for several atomic compounds of this kind occur native. The native gold of the auriferous sands, for example, is an alloy with silver, in the ratio of one equivalent of silver, united with four, five, six, and twelve equivalents of gold, but never with a fractional part of an equivalent. But the alloys being generally, as it were, soluble in each other, this definiteness of combination is not observable in most cases.

The alloys, like the metals, possess metallic lustre, conduct heat and electricity, are, to some extent, malleable, sonorous, elastic, and ductile, and are sometimes susceptible of crystallization. They often differ materially from the elements composing them. The hardness of a metal is generally increased by being alloyed; it is therefore frequently more elastic and sonorous. Alloys are generally less malleable and ductile than the metals composing them. Formed of two brittle metals, they are always brittle; of a ductile and brittle one, they are generally brittle, and are sometimes so when formed of two ductile metals.

The density of an alloy may be either greater or less than the mean density of its elements. Alloys of gold with tin, zinc, bismuth, antimony, or cobalt are examples of the former; those of gold with silver, copper, lead, or iron, of the latter.

The fusibility of metals is greatly increased by alloying, as is well illustrated by the alloy of platinum and arsenic, and the well-known alloy composed of 8 parts of bismuth, 5 of lead, and 3 of tin, which melts at  $212^{\circ}$  instead of  $514^{\circ}$ , the mean of its elements. This increased fusibility is of great practical importance in the arts, and of special use to the mechanical dentist, as will be noticed presently.

The color of an alloy cannot be correctly inferred from the color of its component metals. The alloys of copper with zinc and arsenic are familiar illustrations of this fact.



The tendency of metals to unite with oxygen is generally augmented by being alloyed, and this tendency is often, if not always, the result of galvanic action. According to Faraday, 100 parts of steel, alloyed with 1 of platinum, is dissolved with effervescence, in dilute sulphuric acid too weak to act with perceptible energy on common steel. This can only be explained by assuming that the steel is rendered positive by the presence of the platinum. The same thing is illustrated by the action of dilute acid on commercial zinc.

This tendency of the alloys to unite with oxygen, and the readiness with which most metals oxydize, at their melting points, render some precautions necessary in the process of alloying. In combining tin and lead it is common to cover the surface of the metals with rosin, oil, or other substance having an affinity for oxygen greater than that of the metals. The same general principle, modified to suit circumstances, will answer in all cases.

There is also some difficulty in obtaining uniform alloys from metals differing much in specific gravity. Every dentist has observed this in gold alloyed with silver and copper. Adequate stirring or remelting is the remedy in such cases.

In uniting several metals, difficulty is often experienced from a want of affinity between two or more of them. This is best overcome by uniting in pairs those which combine most readily, and afterward uniting these with each other. For example, a small quantity of lead added to brass produces a useful alloy for some purposes. This, however, would be difficult to accomplish directly, but it is readily effected by first combining the lead and zinc, and then adding melted copper.

Many alloys are important and interesting to the dentist. We will notice a few of these. Pure gold is too soft and flexible for the purposes of mechanical dentistry.



This condition is overcome by alloying it with platinum, silver, copper, etc. In alloying for plate, some prefer silver, some copper, and others, as Prof. Harris, a mixture of both. A very good plate is obtained by alloying pure gold (or ordinary coin) with equal parts of silver and copper, reducing the gold to the required carat. Gold alloyed with platinum is strong and elastic, and is therefore valuable for clasps and backings, a less amount of substance affording the requisite strength. One part of platinum to 10 or 12 of gold will, in general, give satisfactory results.

The increased fusibility of metals when alloyed enables us to unite two metals, or different pieces of the same metal, by a process called soldering. In the preparation of solders, several points require attention. They must be more fusible than the metal or metals to be united, and must be composed of metals having a strong affinity for those to be soldered together. Each metal, therefore, to a certain extent requires a solder peculiar in itself. A very convenient though not a very fine gold solder is made by adding to any quantity of American coin one-third its weight of silver and one-fourth its weight of copper. This is about the same as Harris' No. 1, and answers all ordinary purposes. Many formulas might be given, but those wanting them know where to get them.

Silver solder is the only alloy of that metal of use to the dentist. If silver plate be used, as it may be for temporary work in healthy mouths, the metal should be pure. This may be soldered with silver coin, or with any of the finer silver solders.

Some of the alloys of copper are interesting and useful to the mechanical dentist. Of these we may mention the ancient bronze, composed of tin and copper; and brass, the well-known alloy of copper with zinc. The former of these makes an excellent male cast, but the high tempera-



ture at which it fuses, and its affinity for oxygen at the melting point, render it rather inconvenient for ordinary use. From its hardness, the plate will be "driven home" without any flattening of the prominences on the ridge. When used, it should be melted under rosin, powdered charcoal, pine sawdust, or some similar combustible substance, and, like all other alloys, should be taken from the fire and poured as soon as fused.

Brass, when pure, consists of 63 parts copper to 32 of zinc, being a definite compound, composed of 1 equivalent of zinc and 2 of copper. The brass of commerce is an uncertain compound, containing tin, lead, and other alloys. This is a convenient substance in the laboratory for various incidental purposes not directly pertaining to mechanical dentistry. Cheap and serviceable blow-pipes are constructed from it; and every dentist should be skilled enough to make his own, as a majority of those in market are unfit for use in fine manipulations. It may be soldered with silver coin, any of the silver solders, or the common brass solder composed of 2 parts brass, 1 of zinc, and a minute quantity of tin. It is sometimes used for casts, but is not reliable, on account of its shrinkage in congealing and cooling.

Commercial zinc is an alloy of zinc with iron, lead, cadmium, arsenic, etc. On account of its cheapness, and because it shrinks but little in congealing and cooling, it is much used for casts. It answers a tolerable purpose for ordinary cases, but its shrinkage is often a serious annoyance. The thing needed for casts is a convenient and cheap metallic substance which *expands*, in congealing, precisely as much as it shrinks in cooling from the point of congelation to the ordinary working temperature. An alloy composed of 4 parts of zinc to 1 of tin nearly fulfills these indications. It forms a very hard cast, and may be immersed in lead without the ordinary protection



of whiting or lampblack. Of the alloy of zinc with copper we have already spoken.

Equal parts of tin and lead make a good alloy for female casts. It is harder than either of its constituent metals, melts at a lower temperature than either of them, and, as it shrinks less in cooling, gives a more correct counter-cast. The attention of the profession was directed some years ago, by Dr. Van Emon, to an alloy of tin and antimony composed of, perhaps, 5 or 6 parts of the former to 1 of the latter. This is a good article for casts; can be used with lead for the female casts; and shrinks but little if any in congealing and cooling. It is easily oxydized, and should therefore be fused with the proper precautions, and taken from the fire as soon as melted. From our own experience, we consider the zinc and tin alloy above referred to preferable to this or to any other we have used.

Two parts of lead, one of copper, and one of antimony is the formula for Lassaigne's type-metal. It makes a tolerable cast, expands slightly in congealing, but is rather brittle.

Of the alloy of platinum with gold we have already spoken. With steel it forms a tough, strong alloy—an excellent material for excavators and pluggers. The best proportion is said to be 1 part of platinum to 100 of steel. None of its other alloys are of importance to the dentist.

The only remaining alloys interesting to the dentist, that we now think of, are the mercurials. Of these we have nothing to say at present, and we hope nothing further need be said. Our views on the subject are known to the Society.



## “SOLUBLE QUARTZ.”

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THE readers of the *Register* have all *heard* of “soluble quartz.” It is proposed now to inquire if any of them have *seen* it? and if they have, what of it? What is to be done with it? who is going to do it? and when will he get it done? A long time ago one of our teachers told us, to prove how soon teeth would be filled with “silicious compounds,” that he had a gallon of silex or quartz in a soft state, “like jelly,” and that as soon as he could devise a method of “hardening” it again, he had no doubt that the desire of all dentists would be reached. Various hints have since dropped from the tongues of hopeful aspirants, all pointing to the *silicious* desideratum; and now we hear of “dissolving quartz.”

Well, quartz is crystallized silica or silicic acid. As a mineral, it is well known. It is composed of oxygen and silicon, and is as really an acid as the well-known sulphuric acid. The reason it does not taste sour, and otherwise manifest the ordinary properties of acids, is that it is insoluble. Like all acids, it has an affinity for and unites with alkaline bases, such as potash, soda, and the like. On account of its solidity and insolubility, heat is necessary to its speedy combination with an alkali. The compounds formed by its union with bases are called *silicates*. The different varieties of glass are all silicates.

The alkaline bases are usually *protoxyds*, that is, they are mostly composed of one equivalent of oxygen united with one equivalent of some other element. Thus, potash is composed of one equivalent of potassium and one of



oxygen; and it may serve as a type of the basic oxyds. Now, the acids prefer the alkalies to other oxyds, as a general rule; but when deprived of these, they will unite with the others. Water is the *protoxyd of hydrogen*, and we often find the strong acids combined with it. Liquid sulphuric acid is one equivalent of the *pure acid* combined with one of water. The same is true of nitric acid. When the latter acid unites with potash, the compound is called *nitrate of potash*; and on the same principle, when it combines with water, the compound should be called *nitrate of water*, instead of “liquid nitric acid.”

Bearing these facts in mind, by way of illustration, it will be easier to understand just what is meant by soluble or “dissolving quartz.” If powdered quartz or silicic acid be mixed with soda or potash, and heated to a red heat, the two substances combine. If a carbonate of potash or soda be used, carbonic acid escapes as a gas. The properties of the compounds thus formed vary with the proportions of the materials used. If one part of the powdered quartz be mixed with three of carbonate of potash, and the mixture heated to redness in a crucible, a soluble glass or silicate of potash is formed, the silicic acid being able, by the aid of heat, to take the potash from the carbonic acid.

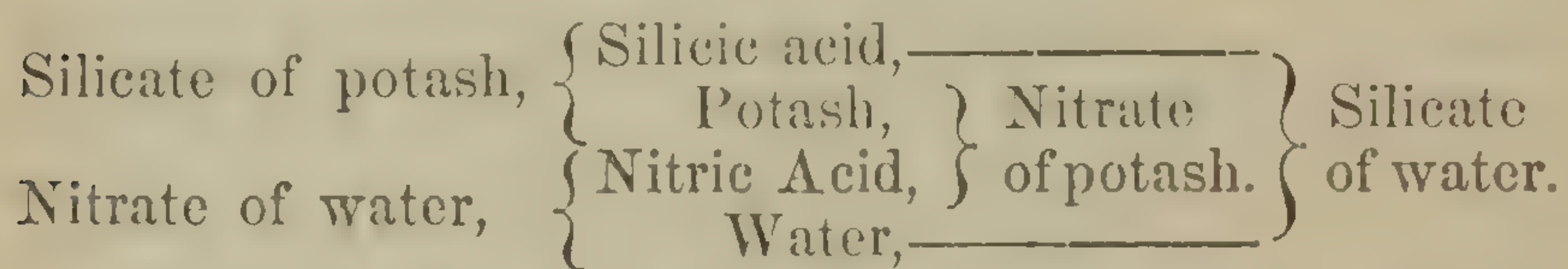
The glass thus formed is easily pulverized, and is readily dissolved in water. When dissolved, if a strong acid, as the nitric or sulphuric, is added to the solution, a gelatinous precipitate is formed. This is the “gelatinous silex” or “soluble quartz.” If it be heated to redness, pure silicic acid, in the form of a fine powder, is obtained. This gelatinous precipitate may be obtained by a variety of processes; but the one here noticed is as convenient as any other.

But what is this gelatinous precipitate? Is it silicic acid or quartz, dissolved or partially dissolved in water?

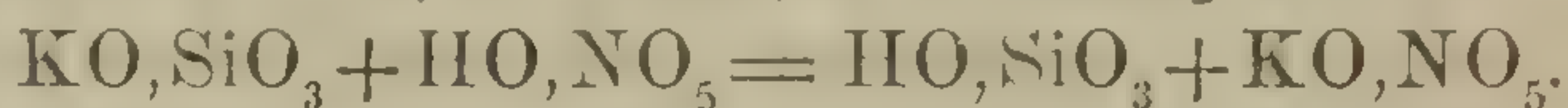


In answer, let us endeavor to comprehend the chemical changes which take place in the process of its formation.

The soluble glass is *silicate of potash* ; and a so-called concentrated acid, which may be added to the solution of the glass to cause the precipitation, is *nitrate of water*. In the change which is effected we have a case of what is called double elective affinity. The reactions will be better understood by a diagram :



Those familiar with chemical notation will understand the matter as well, or better, from an equation :



From this it appears that the quartz, instead of being dissolved in water, is chemically combined with it; and this compound retains its gelatinous form with a goodly degree of tenacity. Its plasticity would enable us to insert it in a cavity in a tooth; but in its gelatinous state it would avail nothing. And if we could devise a ready method of *removing* the water from it, thus *decomposing* the silicate, powdered quartz would be our sole reward.

Soluble *silicates* are common; but soluble *quartz* is, probably, somewhat scarce; and, were it otherwise, it would probably dissolve in the fluids of the mouth as readily as in water.

It is probable that teeth will be filled with gold for a while yet; but we are waiting patiently "to see what we shall see."



## ALLOYING GOLD.

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YOUNG dentists, and perhaps *some* of the old ones, are often puzzled in regard to one of the modes of expression used in designating the quality or fineness of gold alloys. The term "carat" is often a stumbling-block, and is frequently used indefinitely, sometimes, indeed, without any meaning at all. The term is a relative one. The quantity of gold under consideration is supposed to be divided into 24 parts, and each of these parts may be considered a carat. Hence, pure gold is said to be 24 carats fine, or simply "fine gold." If one of the 24 parts be a baser metal than gold, the alloyed mass is said to be 23 carat gold; if 6 of the parts are base metal, it is 18 carat gold; if one-half be base metal, it is 12 carats, etc. By observing this the whole thing is perfectly plain. For example, if we speak of 19 carat gold, we simply mean that every 19 parts of pure gold it contains are united with five parts of silver, copper, or some other metal.

Much of the gold plate used by dentists is alloyed by guess, and more still, perhaps, by arbitrary rules or recipes, without any reference to, or knowledge of the quality of plate produced. This, to say the least of it, is not satisfactory to the individual operator, nor flattering to the profession. It is annoying to any man of spirit to work without a proper knowledge of that with which he works; and when this can be so readily obtained in the present case, there is but little sympathy due to those who permit themselves to be long thus annoyed.



In compliance with the request of some of the younger members of the profession, we will give a few simple rules, which we find convenient in our own practice. We are not aware that there is anything new or peculiar about them, nor will we try to be very technical or concise in the statement of them. We wish the principles on which the rules are founded to be understood, and then they can not be forgotten, while, if these are not understood, they will not be remembered. The rules will be more readily understood by bearing in mind that 24 is the number of parts into which any quantity of gold under consideration is supposed to be divided.

Let us suppose, then, that it is desired,

1. *To ascertain the carat of any given alloy.*

The proportion may be expressed as follows:

As the weight of the alloyed mass is to the weight of gold it contains, so is 24 to the standard sought. Take, for example, Harris' No. 3 gold solder:

Pure gold,	6 parts.
“ silver,	2 “
“ copper,	1 “
<hr/>	
Total.....	9 “

The proportion would be expressed thus,  $9 : 6 :: 24 : 16$ .

From this any one can deduce the following

**RULE.**—Multiply 24 by the weight of gold in the alloyed mass, and divide the product by the weight of the mass; the quotient is the carat sought.

In the above example, 24 multiplied by 6, the quantity of gold, gives 144, which, divided by 9, the weight of the whole mass, gives 16. Hence, an alloy prepared as above is 16 carats fine.

As another example, under the same rule, take Harris' No. 1 solder:



22 carat gold,	48 parts.
silver,	16 “
copper,	12 “
	—
Total.....	76 “

Now, as the gold used is but 22 carats fine, one-twelfth of it is alloy. The one-twelfth of 48 is 4, which, subtracted from 48, leaves 44. The statement then is :

$$76 : 44 :: 24 : 13\cdot9.$$

This solder, therefore, falls a fraction below 14 carats.

2. *To reduce gold to a required carat.*

The proportion may be expressed as follows:

As the required carat is to 24, so is the weight of gold used to the weight of the alloyed mass when reduced. The weight of the gold subtracted from this, gives the quantity of alloy to be added.

For example, reduce 6 ounces of pure gold to 16 carats. The statement is expressed thus :

$$16 : 24 :: 6 : 9.$$

Six subtracted from 9 leaves 3, which is the quantity of alloy to be added. From this is deduced the following

**RULE.**—Multiply 24 by the weight of pure gold used, and divide the product by the required carat. The quotient is the weight of the mass when reduced, from which subtract the weight of the gold used, and the remainder is the weight of alloy to be added.

As another example, under the same rule, reduce 1 pennyweight of 22 carat gold to 18 carats.

As the gold is only 22 carats fine, one-twelfth of it is already alloy. The one pennyweight, therefore, contains but 22 grs. of pure gold. The statement is, therefore, thus expressed :

$18 : 24 :: 22 : 29\frac{1}{3}$ . Twenty-four subtracted from  $29\frac{1}{3}$  leaves  $5\frac{1}{3}$ . Therefore, each pennyweight of 22 carat gold requires  $5\frac{1}{3}$  grains of alloy to reduce it to 18 carats.



3. *To reduce gold from a lower to a higher carat.*

This may be done by adding pure gold, or a gold alloy finer than that required. The principle of the rule may be set forth in the following general expression :

As the alloy in the required carat is to the alloy in the given carat, so is the weight of the alloyed gold used to the weight of the reduced alloy required. This principle may be practically applied by the following

**RULE.**—Multiply the weight of the alloyed gold used by the number representing the proportion of alloy in the given carat, and divide the product by that representing the proportion of alloy in the required carat ; the quotient is the weight of the mass when reduced to the required carat by adding fine gold.

To illustrate this rule, take the following examples :

Reduce 1 pennyweight of 16 carat gold to 18 carats.

The numbers representing the proportions of alloy in this example are found by respectively subtracting 18 and 16 from 24. The statement is, therefore,

$$6 : 8 :: 1 : 1\frac{1}{3} ;$$

from which it follows that to reduce one pennyweight of 16 carat gold to 18 carats, there must be one-third of a pennyweight of pure gold added to it.

But suppose that, instead of pure gold, we wish to effect the change by adding 22 carat gold. The numbers then respectively representing the proportions of alloy would be found by subtracting, in the above example, 16 and 18 from 22, and the statement would be,

$$4 : 6 :: 1 : 1\frac{1}{2}.$$

It follows, then, that to each pennyweight of 16 carat gold a half-pennyweight of 22 carat gold must be added to bring it to 18 carats.

By the above rules we think the student will be able, in all cases, to calculate the quality or fineness of his gold, and to effect any reduction, whether ascending or descend-



ing, which he may desire. This article is written expressly for dental students and the younger class of practitioners. Many of the older members will, doubtless, laugh at it, and regard it as very *simple* (?), but they should remember that though it may be a long time since they were young, yet it is not long since we were, and, therefore, not long since we very much desired just the simple information contained in the above.



## MANAGEMENT OF GOLD ALLOYS.

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WE have been frequently solicited by some of our young professional friends to insert in the *Register* a few practical remarks on the treatment of gold scraps and filings in the dental laboratory. In complying with this request we will endeavor to be understood, without attempting to be *scientific* or minute. Various processes and manipulations may be resorted to successfully, and almost every dentist has his favorites; hence many may think our suggestions are not the best that might be given, and this opinion is very likely to prove correct.

The appropriate metals for reducing gold to the standard required for dental purposes, as all know, are silver, copper, and platinum. It is sometimes desirable to raise the standard of gold alloyed with these, or to remove them entirely from the mass. But the principal trouble with scraps and filings arises from the presence of what are called base metals. Of these, iron, tin, lead, and zinc are those most frequently met with. Any of these, in appreciable quantity, renders the gold brittle and unfit for use, yet they differ somewhat in their influence on it. Tin causes less change of color than the others; but it forms a more brittle alloy with gold than any of them. The alloy of gold and lead is darker colored than that formed with tin, and is nearly as brittle. Zinc seems to have less affinity for gold than either tin or lead, and hence it appears to be unequally distributed through the alloy, and the consequence is that some parts of the ingot are far



more brittle than others. If the attempt to roll it into plate be made while it is in this condition, some parts of it may manifest a good degree of plasticity or malleability, while small spots will crack, causing the plate to be full of holes. The presence of platinum imparts to the alloy an exceedingly dull color, and it increases its hardness and elasticity, but does not render it brittle. To sum up these points:—when the alloy is very brittle, while the color is rather bright, we may infer that tin is present; if the color be very dull, while the alloy is tough and elastic, platinum may be suspected; if the mass be both brittle and dull colored, lead is probably present; and if the brittleness be confined to limited spots, the presence of zinc is indicated.

In all our remarks thus far, we have taken it for granted that the base metals are present in only minute proportions, or that the gold greatly predominates over them. We are endeavoring to describe such alloys as the mechanical dentist is liable to meet with after taking what he supposes to be due care to prevent their formation. He will often find alloys not possessing any of the specific characters described above, for he may have several base metals combined with his gold at the same time.

Before noticing the method of separating gold and platinum, and the mode of obtaining pure gold, we will speak of the “dry process” for separating minute particles of base metals from dentists’ gold. The scraps are supposed to be under treatment, and are known to be 18 or 20 carats fine, but in handling, a trace of one or more base metals is melted with them, and the gold is rendered unfit for use.

Now if, when the alloy is in a liquid state, some element be brought in contact with it which, by virtue of its affinity for the base metals, is capable of separating it from the gold, our end is accomplished. Whatever element be used, it must, of course, have a stronger affinity



for the base metal than for the gold. And, fortunately, we are at no loss here, for gold has but little affinity for any of the non-metallic elements.

The only elements relied on, in the process under consideration, are oxygen, chlorine, and sulphur. The base metal is to be separated by converting it into an oxyd, a chloride, or a sulphide. Without being considered responsible for the etymology used, we will speak of the three processes under the titles of *oxydation*, *chloridation*, and *sulphidation*.

If we attempt to purify our gold, then, by oxydation, we want some compound containing oxygen, which is decomposed by heat. A variety of substances might be used, but nitrate of potash will usually accomplish all that can be obtained by this process. This salt is readily decomposed by heat, and the decomposition results in the liberation of oxygen. This may be more clearly understood by a glance at the formula representing its composition:  $\text{KO},\text{NO}_5$ . For the sake of the non-chemical reader, I may be allowed to remark that **K** is the symbol of potassium, **O** that of oxygen, and **N** that of nitrogen. (Potassium being formerly called *Kalium*, explains the retention of the symbol **K**.) Potassium and oxygen uniting, form potash; and nitric acid,  $\text{NO}_5$ , uniting with this, forms nitrate of potash, which is the *nitre* or *saltpetre* of commerce. Of the three elements composing this salt, oxygen is the only one that can act on the base metal, for nitrogen has but little affinity for anything, and potassium has none for this class of metals. But oxygen is abundantly liberated as the nitrate is converted into a hyponitrite, thus:



Concluding, then, that this salt can do nothing but oxydate, we can readily understand how and when to use it.

When our brittle alloy is melted, a small quantity of the



nitrate should be dropped into the crucible, without taking it from the fire; and, if thought necessary, additional quantities may be used till purification is effected. The roasting should be continued for some time, and it is often necessary to pour and resume the process in a clean crucible, as the slag sometimes prevents the free access of the oxygen to the alloy. By a little practice the manipulator will learn the various minutiae of the process.

The process of oxydation of course is not adapted to the separation of a metal from gold, which has but little affinity for oxygen. We mention this only because we have known dentists to roast their alloys with saltpetre for hours in succession, in an endeavor to separate platinum from gold. As neither metal is oxydated under such circumstances, the effort is simply a waste of time and fuel.

The process of oxydation, then, is to be resorted to when the base metal is readily oxydized. But if it have but little affinity for oxygen, then we should inquire into its affinities for chlorine and sulphur. Thus, if it be tin, for example, we could remove it better by chloridation than by oxydation.

Chloridation should always be resorted to when the base metal has a stronger affinity for chlorine than for oxygen or sulphur. Any compound which yields chlorine by the application of heat, and at the same time introduces no troublesome material into the alloy, will answer the purpose. Some chlorides are not readily decomposed. For example, common salt, which is chloride of sodium, sustains a high heat without decomposition, and, consequently, will not answer our purpose. The compound which we prefer is the chloride of mercury, commonly called corrosive sublimate. It has several advantages over most other chlorides. It yields chlorine readily by the application of heat; and at the same time the mer-



cury, instead of uniting with the gold, is driven off in the form of vapor. It may be used as directed for nitrate of potash in the process of oxydation; but smaller quantities should be added at once, to prevent waste; and, indeed, smaller quantities will answer the purpose.

The well-known "sal ammoniac" is used for the same purpose, and in about the same way. This salt is the hydrochlorate of ammonia (or, possibly, chloride of ammonium), and it yields chlorine by decomposition with heat.

Of course it is not practicable to separate, by this process, two metals which differ but little in their affinity for chlorine. Those who try to separate gold and platinum in this way, will accordingly fail. We have known some to roast, first with saltpetre, and then with corrosive sublimate, and then become disheartened, because their plate, though sufficiently tough, was still of a bad color. More than once such gold has been sent to us to be refined, accompanied with a long, graphic history of the tortures it had endured, and the obstinacy with which it resisted refinement by roasting.

To remove the base metals, sulphur is sometimes dropped into the crucible after the alloy is melted, the manipulations being about the same as in oxydation with nitrate of potash. But as all elements act with greater energy in their nascent state, that is, just as they are being liberated from a compound, if a sulphide which is readily decomposed by heat be used, the process of sulphidation will be more active. In selecting a sulphide it is desirable to choose one which will not be the means of introducing a troublesome ingredient into the gold. For example, if a sulphide of zinc were used for the removal of lead, we would gain little or nothing; as, instead of an alloy of gold and lead, we would have one of gold and zinc.



The native ore of antimony is, perhaps, the most convenient of the sulphides. This is a sesquisulphide, and is readily obtained in most drug-stores. It is desirable to resort to sulphidation only when the alloy is rendered very coarse by the presence of base metals. The alloy should be melted in a large crucible, and about twice its weight of the native sulphide should be added, a small quantity at a time; and the roasting should be prolonged in proportion to the quantity of base metal present. As the sulphide is decomposed, the sulphur unites with the base metals, converting them into sulphides, and the antimony unites with the gold, forming a leaden-colored alloy. The antimony is to be expelled by melting the alloy in a clean crucible and forcing a current of air on its surface with a bellows. The antimony is oxydized and passes off in vapor. The air should not be applied too rapidly at first, as the rapid escape of the oxyd of antimony might carry off portions of the gold with it. A distinctly visible escape of vapor is evidence of sufficiently rapid oxydation. As the antimony escapes, the melting point of the alloy rises. The force of the fire must, consequently, be increased.

We conclude, then, that if lead be the contaminating metal, the oxydating process is the preferable one. Nitrate of potash will, therefore, answer the purpose. It is important to use clean crucibles, and to change for fresh ones if a prolonged roasting is necessary. Zinc may be separated by either oxydation or chloridation, without much difficulty. Tin is much more readily removed by the latter than by the former process. Indeed, it is oxydized with such difficulty that, when protected by the gold, it is almost impracticable to remove it entirely by oxydation. Iron may be separated by any of the three processes.

In many cases, tin, lead, and zinc are all present. If



persuaded of this, we usually begin with oxydation. If, after reasonable roasting with nitrate of potash, the alloy is still brittle, we infer that the difficulty arises from the presence of tin, and we use the chloride of mercury (corrosive sublimate).

But if the alloy be very impure, we prefer the wet method, which we will notice directly, and by which we obtain pure gold, which may be reduced to the required standard.

The management of filings, with but slight modifications, is to be conducted on the same principle as that of scraps. Particles of iron or steel derived from the file are usually present. These may be readily removed by the magnet before commencing other treatment. By digesting the filings with nitric acid, in a glass or porcelain vessel, the base metals are oxydized, and converted into nitrates, which are soluble, and may then be removed by washing with water. Metals, when minutely divided, do not always flow readily together when melted in a crucible. The tendency is to the formation of minute globules, which remain separated from the mass. A good method of overcoming this is to use, as a flux, the dry carbonate of potash, the *sal tartar* of the shops. If the crucible be lined with borax, and the filings be added, after digesting in nitric acid, the addition of an equal bulk of the carbonate will answer all purposes. By raising the heat to the melting point of the filings they will run together into a single mass, which may be refined if necessary, as above described for the treatment of scraps.

It is scarcely necessary to mention the use of borax as a flux in this connection. When the gold is of the proper quality for dental purposes, the addition of borax protects it from oxydation, which might, when unprotected, lessen the relative quantities of copper and silver in the alloy. And as all metallic oxyds are soluble by heat in



this salt, it insures clean metallic surfaces for contact, and consequently a ready flowing together of the melted metals.

When the alloy is composed of metals differing but little in their affinities for oxygen, chlorine, etc., we resort, as stated above, to one of the "wet methods. And in this connection we will only describe the one which we consider the most convenient and effectual for the practical dentist. It is effectual in all cases, as it always gives us pure gold.

Let us, then, suppose that our gold alloy has become contaminated with platinum to such extent that the color and elasticity of the plate are objectionable. The alloy should be dissolved in nitro-hydrochloric acid, called *aqua regia*. The best proportions for aqua regia are three parts of hydrochloric acid to one of nitric. If the acids are at all good, four ounces of the aqua regia will be an abundance for an ounce of the alloy. The advantage of using the acids in the proportion of three to one, instead of two to one, as directed in most of the text-books, is that when the solution is completed there is but little if any excess of nitric acid. If the acids be "chemically pure," four parts of the hydrochloric to one of the nitric produces still better results.

By this process the metals are all converted into chlorides; and as the chloride of silver is insoluble and has a greater specific gravity than the liquid, it is found as a grayish-white powder at the bottom of the vessel. The chlorides of the other metals, being soluble, remain in solution. By washing and pouring off, allowing the chloride of silver time to settle to the bottom, the solution may be entirely separated from it. The object is now to precipitate the gold while the others remain in solution. This precipitation may be effected by any one of several different agents; but we will mention only the protosulphate of iron.



This salt is the common green copperas of the shops; and as it is always cheap and readily obtained, we need look no further. It should be dissolved in clean rain-water, and the solution should be filtered and allowed to settle till perfectly clear. Then it is to be added gradually to the gold solution as long as a precipitate is found, and even longer, as an excess will the better insure the precipitation of all the gold. The gold thus precipitated is a brown powder, having none of the appearances of gold in its ordinary state. The solution should now be filtered, or the gold should be allowed to settle to the bottom, where it may be washed after pouring off the solution. It is better to filter than decant in this case, as frequently particles of the gold float on the surface, and would be lost in the washings by the latter process.

Minute traces of iron may adhere to the gold thus precipitated. These can be removed by digesting the gold in dilute sulphuric acid; and, when the process is properly conducted thus far, the result is PURE GOLD, which may be melted, under carbonate of potash, in a crucible lined with borax, and reduced to the desired carat.

The chloride of silver may be decomposed by mixing it with granulated zinc, and digesting it in dilute sulphuric acid. The hydrogen thus generated takes the chlorine to form hydrochloric acid; and pure silver is left in a fine powder, which may be melted under borax or carbonate of potash. Or, if the carbonate of potash be first fused in a large crucible, and the chloride gradually added, it is decomposed; and when the heat is raised to the melting point of silver, the metal flows to the bottom of the crucible, where it should be allowed to cool, as it would not readily pour from the crucible under such circumstances.

The separation of the platinum from the solution will probably be noticed in some other connection.



## THE COLD WELDING QUESTION.

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AT the New York meeting of the American Dental Convention, three years ago,\* the welding properties of gold were referred to, when some member suggested that there were but *two* welding metals, and that these were iron and platinum. We then remarked that this assumption was incorrect; for gold was pre-eminently the welding metal, as every worker in *pure* gold well knew. We had reference to the practice of gold-beaters uniting fragments of leaves by pressure with a smooth-edged instrument. Prof. Austen remarked (though in the report the statement is credited to Prof. Buckingham) that if it were true that pressure would weld gold in a cold state, it was a new fact in chemistry. Prof. Buckingham then, and afterward in the *News Letter*, maintained that the union of gold by pressure was not welding, but rather a species of riveting—as when two sheets of metal were laid together and a punch was driven through both at various points, they would adhere together. And, indeed, this theory leads to the inquiry as to the existence of welding properties in any metal. In uniting two pieces of hot iron, the particles of one may be driven into the pores of the other, and retained there by riveting.

Another theory was that as gold could only be thus united when freshly annealed, the union would not be permanent, but that the particles, losing their adhesive-

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\* This was first published in 1859.



ness, would separate. This was maintained earnestly by Mr. James Leslie, at a meeting of the Mississippi Valley Association. In advancing his theory he gave many interesting facts; and, finally, annealed three leaves of No. 6 foil, and united them by the pressure of his finger—suggesting, however, that they would, on exposure, lose their adhesiveness and separate. We purchased these leaves, and exposed them “to all weathers” for ten months, and throughout they remained inseparable. Notwithstanding it contradicted his theory, no one was better pleased with the result than Mr. L.

Long before this, Dr. A. M. Leslie had maintained that gold foil was as adhesive as crystal gold; and we suppose, to this day, finds no good reason for a change of opinion.

But we set out to notice the progress of opinion on this subject in a few short years. All in the profession are now familiar with this property of gold; and it is almost if not quite unanimously regarded as *welding*. Prof. B., we believe, has dropped his rivet theory, and Prof. A. no longer regards it as a *new fact in chemistry*, but speaks of it, in his late article on gold, as a well-known and well-established principle. Mr. L. is not concerned about the separation of welded gold, even though it be true that exposure interferes with or destroys its adhesive properties; especially when he remembers that though a reduction of temperature destroys the welding properties of iron, it does not separate two pieces already welded.

This subject affords us satisfactory evidence of the progressiveness of our profession; and the extensive use of adhesive foil, as recommended by Prof. Arthur, shows that practice keeps pace with theory.



## PAINLESS SURGERY.

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DR. LIVINGSTONE, the celebrated African traveler, states that when torn by a lion, he felt no pain. Was it because the wounds inflicted were trivial? Certainly not; for the shoulder was crushed, and the humerus fractured so severely that a false joint is the result. Then think of the contused and punctured wounds inflicted by the jaws and teeth of the animal. He was not in a state of stupor bordering on coma; for he was able to observe minutely the actions of the lion, and to notice all the surrounding circumstances. He was not, probably, laboring under a state of depressed nervous action, for his energies were aroused and he was the aggressor in the fight. Had he been fully under the influence of ether or chloroform, we would not be surprised to hear that he was unconscious of pain during the onslaught of the lion; but all the circumstances warrant the belief that his nervous system was in a very different if not in the very opposite condition to that produced by chloroform.

But, after all, is there anything very extraordinary in Dr. L.'s exemption from pain under such circumstances? In battles,\* mobs, or street-fights, do not many receive severe wounds of which they are not conscious at the time? or if conscious, do they not fight on without a sense of pain, even when disabled by fracture or loss of

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\* This was written before the war. Hundreds of cases during the war illustrate and confirm the idea here suggested.



blood? Does not every rollicking schoolboy know that when "fighting mad," a sound drubbing hurts him far less than when under a calmer mental condition?

Now, if we could devise a convenient method of rousing the nervous system up to the painless point, we would like it much better than the plan of depressing it by anæsthetics below the point of feeling. And if we could act successfully on only those nerves concerned in any given operation, the result would be as satisfactory as if the whole nervous system were thus influenced. And something like this, we believe, is sometimes accomplished by the use of a galvanic current in the extraction of teeth. It is needless to deny that, in many cases, the pain of the operation is very much lessened, if not totally abated; and we know of no better method of accounting for the fact than by the hypothesis above suggested. In short, we believe that the dental nerves, during a successful application of the battery, are in the same condition that Dr. Livingstone's were when the lion had him.



# REPLY OF THE GRADUATING CLASS

TO THE

Valedictories of Professors Allen and Smith.\*



*To the Faculty of the Ohio College of Dental Surgery.*

GENTLEMEN :—The present moment is to us one of peculiar interest. It is a period in which strong ties are severed, strong feelings aroused. The social ties binding us together as classmates are now to be severed, as each selects his field of labor.

But other ties are rent. For months we have been your pupils, and pleasant to us has been the relation; but by this evening's acts you have declared us your pupils no longer. We have looked up with longing eyes to the platform of professional distinction occupied by you—now you have lifted us up, and set us beside you.

If we may be allowed to believe that this is not a mere act of clemency, but the result of your deliberate judgment, aided and assisted by the examining committee, it would be an affectation of modesty to say we do not feel flattered. But when we reflect that your own integrity, your sense of justice, your responsibility to the public, and your *jealousy* for the honor of your profession, would

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\* Delivered February, 1854, and included here at the request of a classmate.



all influence your decisions, we are proud of the position we now occupy.

This epoch in our lives is called our "commencement." It is the commencement of our professional career—the commencement of our life's struggle in the cause of health and humanity—the commencement of our professional battle with empiricism in all of its forms and under all its disguises. With progress for our watchword, *truth* for our emblem, and science for our standard-bearer, may we press on, assured that in time the victory will be ours.

Though always anticipated with longing eye, yet this period is never passed without regret.

Our relation to society being changed, new duties arise, new difficulties are to be encountered, new trials met, and new obstacles overcome.

The young soldier who, from a safe position, views the distant battle, knowing that in the next he will be a participant, is by no means a careless spectator. Thus have we looked on the trials and struggles of professional life. But being now "enlisted for the war," our *commissions* "signed and delivered," how infinitely more vivid become our views of the responsibilities involved! Feeling these responsibilities, and looking forward to the trials and difficulties, especially those to be met at the very outset, 'twere human nature to shrink from the contest. But, encouraged by your own success, influenced by your example, guided by your counsel, qualified by your instruction, and indorsed by your judgment, we hope to press on, resolved, not to "do or die," but to *do*.

As we have looked forward to this occasion, so will we look back to it. The wanderer in the wide world, through youth, through manhood, and when his locks are gray, looks back, in memory, to the parental roof, and cherishes the recollections of his childhood's home. And there is ever one scene which looms up, like the blue mountain-



top, far above its fellows. This one scene, in all its circumstances, is impressed on every page of his memory's book. One day is sacred and dear above all days spent in that home. That scene is the parting scene—that day is the one in which the parental mansion ceased to be his home—the day in which he cast himself on the world, assuming the duties and responsibilities of manhood. So will our minds turn instinctively to this evening and its scenes—so will we remember the closing period of our collegiate and the “commencement” of our professional life; and as the wanderer clings to and cherishes the parental gifts—the parting tokens—so will we honor and prize this,\* and especially this,†—the parting tokens of our “Alma Mater.”

But, though our pupilage is terminated, still we are students. Vast fields of professional science lie open, inviting us to cultivate them; nay, much lies not only unoccupied but unexplored, awaiting the visit of the hardy adventurer. There is, then, room for the fullest exercise of that professional ambition which ever aims at the advancement of our profession for the good of our race.

May the progress of the past be our encouragement for the future; and as you and your brethren have borne your part in that which is past, may we hope to join with and assist you in that which is future. May we—may our profession—labor hand in hand, some cultivating principles already planted till they grow up to perfection, others exploring new fields and developing new principles—each pursuing that for which nature and the circumstances of life have fitted him—all aiming at that mutual improvement which alone is capable of elevating the profession. While thus striving, may we cultivate a laudable spirit of emulation, a spirit of generous rivalry;

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\* The diploma.

† The Holy Bible.



but may we never mar the interests of our cause by professional jealousy, nor cripple its energies by professional selfishness.

In our intercourse with professional brethren, may we ever obey the spirit of that divine injunction: "Freely ye have received, freely give."

In the name of the class, I bid you farewell.



## FACIAL NEURALGIA.\*

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I PRESUME that dentists and physicians fail very many times for want of a correct diagnosis of the cause of neuralgia, which is often very obscure. Suppose a ligature were placed around a nerve trunk, and suddenly drawn so tight as to cut off all communication. The subject would feel a sudden thrill of pain, and then a numbness—would feel, at the time and afterward, as if the nerve trunk had been severed. But if drawn only so tight as to prevent the free action of the nerves, but not to cut off all communication, there would be intense pain felt at their sentient extremities.

If a surgeon or a dentist has charge of a case of *tic douloureux*, he will probably take for granted that there is bony pressure on the nerve trunk, and that it is scarcely amenable to treatment. I think that in a great majority of cases there is no such pressure by bony deposits, but by thickening of the investing membrane or of the periosteum that lines the bony canal. Such cases are certainly amenable to treatment. Many, in such cases, extract teeth, give quinine, calomel, and finally get quit of a troublesome patient by sending him to a watering-place. Such cases can nearly always be relieved by a course of iodide of potassium. This is a neutral salt. Its elements have each strong affinities for certain constituents

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\* Substance of a speech before the American Dental Association.



of living tissue, but the salt, as such, has almost no such affinity.

The action of this salt may be illustrated by a common practice of Western hunters. They chain two dogs together till they get to the woods, and then let them loose to start the game. Their powers are not exhausted by previous rambling. So we may chain the iodine and the potassium together and start them into the blood. They do not then cause much local action—are as tame as the chained dogs. But if we would start the iodine by itself, we would not get much of it into the blood, because it would combine with organic tissues by the way. And potassium by itself would form potassa, by combining with oxygen, and would spend its force in local action. But combine them and they form a salt that can go wherever the blood can go—even where the blood corpuscles cannot go. Being neutral and highly soluble, it is readily carried throughout the system; and when there it is gradually decomposed, in obedience to stronger affinities than those holding its elements together. The iodine finds something it likes better than the potassium, and combines with it; and the potassium, without going into mourning, marries oxygen, forming potassa, which is a solvent of all organic tissues. The potassa holding the morbid products in solution, and the iodine combining with them (they being in a more favorable state for chemical action than healthy tissues), they are carried out of the organism by the various excretories. When the morbid matter is all carried away, the disease is cured.

The illustration of the chained dogs may be carried still further. They get fretted and angry at the restraint, and when released, revenge themselves on the game. That is the case with these elements. It is a chemical fact that, when any substance is set free from combination, it acts



with greatly increased energy. So, when the iodine reaches the point desired, and is there decomposed, its elements in their nascent condition (like the excited condition of the dogs) act with this increased energy on whatever offers the least resistance. The vitality of morbid tissues being below that of normal ones, offers less resistance to chemical action, and hence they are overcome while the others remain. Of course this is not the real state of the facts, as chemical and vital actions differ; but the dog illustration is given to assist your memories. The potassa uncovers the game, the iodine seizes it (that is, combines with it), and the various excretories carry it out of the system. I have not tested the perspiration to find whether iodine comes out through the pores of the skin, but I have detected it in the saliva and the secretion of the Schneiderian membrane.

Now, my opinion is that, when you find a persistent and troublesome case of facial neuralgia, and do not find diseased teeth to explain it,—and even if you do, but fail to give relief by treating the teeth,—you may suspect pressure on the nerve trunk; and as in but few cases the pressure will result from ossific deposit, relief may be obtained by a course of the iodide, say six to ten grains three times a day.



## THE DENTAL PROFESSION AND ITS APPROPRIATE WORK.

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A Valedictory Address to the Graduates of the  
Ohio College of Dental Surgery—Session of  
1856-'57.

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GENTLEMEN :—Day after day, for months past, it has been our privilege to meet you in the halls of this institution, and to address you on the subjects respectively assigned us. We need not now tell you that we have regarded this as a happy privilege, nor allude to the fact, that no circumstance has transpired during the period of our association calculated to mar the happiness of our intercourse. Nor would it at all become us to refer to the manner in which we have severally discharged our relative duties—we as teachers, and you as pupils; for, of our efforts, you are better able to judge than we can be, and the evidence of faithfulness on your part is already in your hands, in a visible and tangible form, and may be “seen and read of all men.” But terrestrial associations are not permanent, and earthly ties are soon broken. The relations which we have sustained toward each other, for a lapse of time, are now at an end, and you go from us. But still, before you go, we must be allowed to offer, and you to receive, an additional evidence of our interest in you, and our desire for your future success. As the youth departs from the paternal mansion to engage in



the battle of life, the parents bid farewell again and again, painfully prolonging the parting scene, and all to postpone, for a little, the period which snaps asunder the family tie. So we, though the tie is broken—though no longer our pupils—now offer you a few words of parting advice, as if to prolong that relation which has afforded us so much rational enjoyment. Nor will it surprise any, that in our remarks we forget all others, and address only you. The many friends who greet us by their presence will not feel slighted; for they are here on account of the interest felt for you in the position you occupy, and their thoughts being all toward you, and their feelings in sympathy with you, it would seem to them unnatural and out of place, should our thoughts wander from you to address them. And your late classmates will not feel that in addressing you we are neglecting them; for the members of the household who remain are never jealous of any attentions bestowed on the departing.

As this is the *commencement* of professional life with you, and as you are now fully initiated into the membership of the Dental Profession, we do not know that we can better occupy your time than by offering a few remarks respecting that profession and its appropriate work.

The dental profession came into existence at the call of suffering humanity, and is a necessary result of enlightened and refined civilization, acting in concert with an advanced state of medical science. Though a distinct profession, it belongs to the great family of medicine and surgery,—in short, it is a branch and part of the medical profession. In periods long gone by, when medical knowledge was confined to a few leading facts, contaminated with error and superstition, dental science, as now developed, was an impossibility. But when this knowledge became vastly extended by the energy of its votaries,—



when all the sciences were explored and made tributary to its advancement—when the sun of science had dissipated the darkness of superstition and dispelled the gloom of error, then the field of medical science was exhibited in its vast extent—too vast, indeed, for any individual mind to cultivate so as to develop all its resources for good. A division of labor was the natural consequence. When the farmer finds his fields too large, his grounds so extensive that light crops are the only rewards of his extended toil, and this, too, from the fact, that when his labors are diffused over the entire domain, each part receives but a partial and imperfect cultivation, if endowed with good judgment, he limits his efforts to a part of the tract, and, by the concentration of his energies on this, he develops all its resources, and his toil is requited with abundant crops. So it has been with the medical profession. The field became so large that it must all be very imperfectly cultivated, or parts of it neglected, unless by a division of labor, and a harmonious assignment of the laborers, this could be prevented. It is on this principle that specialties in medicine are founded, the profession of your choice being one of them, and the one, perhaps, just now the most prominent of all in the public mind.

The dental profession, we have said, is a *branch* of the medical. The figure is an impressive one. And who has not seen the branch, while attached to, and a part of the parent tree, languish and pine, for want of a due proportion of the nourishing sap which is appropriated by its more prominent and thrifty comrades? And how often have we seen the same small and stunted branch removed from the parental stem, and transplanted into appropriate soil, where it takes root, grows with the vigor of youth, becomes itself a tree, and stands in majesty and beauty the pride and peer of its parent?

Much like this is the history of dental science. While



it was cultivated only in connection with general medicine, it made but little progress. Dental disease was overlooked, if not disregarded, on account of the claims of diseases more serious and fatal. Operations on the teeth were ignored, because more important ones preoccupied the mind of the surgeon. To corroborate these statements, it is only necessary to refer to the prominent agencies in the advancement of medical science, the schools, and the literature of the profession. Look to either of these sources for information in regard to dental science, and the little you will find will barely repay the research. Indeed, while our *branch* was cultivated as a part of the *parent tree*, the real nature of the most prominent dental disease was not discovered, nor even suspected.

We do not intend by these remarks to reflect on the character of the medical profession, nor, in any degree, to charge its members with intentional neglect of the dental apparatus. Far from it. As well might we find fault with the farmer for harvesting his field crops to the neglect of his kitchen garden. But we do, on account of this state of affairs, regard the existence of our specialty as an evident necessity. When our branch was removed from the parent profession, implanted in the soil of science, refreshed by the dews of art, and enlivened by the light of genius—when it sent forth its roots in the shape of dental societies, periodicals, and colleges, then it grew and prospered “like a tree planted by the rivers of water,” sending out its boughs unto the sea, and “its branches unto the river,” and now it stands the companion of its parent in relieving the ills of suffering humanity, and restoring the charms of faded beauty.

The members of the parent profession, to a great extent thus relieved from the care and responsibility connected with dental disease, have the more time to devote to other morbid conditions, and thus, by a division of labor, the



advantages are mutual and general; and the success of our attempt at *standing alone* will, no doubt, tend to produce a still further division, which, if properly made, we are convinced will produce equally satisfactory results.

It would be well, gentlemen, for you and for us all to take a profitable hint from the figure just used. The implanted branch always truly reflects the character of the parent tree. If the one be an oak, the other never becomes an elm, and far less a bramble. So we, though now organized and acknowledged as a distinct profession, should faithfully reflect our parentage by acting at all times worthy of the great medical profession of which we claim to be a humble part. We should always look to the light of genuine science to guide us in cases of doubt and difficulty; and we should ever press onward and upward to that perfection which all should desire. And, in accordance with our genealogy, we must see that we act worthy of the liberal profession to which we belong. We must not permit it to degenerate from its inherited position to that of a mere mercenary trade. We must remember that we are soldiers enlisted in the cause of humanity, and that therefore empiricism is not only unworthy of us, but hostile to us, and is indeed the prominent foe which we are called to oppose.

Activity is the natural condition of man. We not only live in a busy world, but our world is a part of a busy universe. Our Creator, though he works either with or without *means*, never works, either in creation or providence, without motive. And as the dental profession has come into existence in subservience to his providence, we conclude it exists for a definite purpose—that it has a special and appropriate work. And as we believe the profession has not yet fulfilled all its mission, this work may be appropriately viewed in its progressive state. Examined in its several parts, we might consider the por-



tion already done, that now in progress, and the part yet undone.

In considering that portion of the work already done, we will understand ourselves better by casually noticing the early condition of the profession, or perhaps the state of medical science during the formative period of our profession. It would seem, from the best evidence extant, that as early as the days of Herodotus, medicine and surgery were distinct professions, and that the latter was subdivided—dental surgery being one of its divisions. In the palmy days of Greece and Rome dental surgery was cultivated to some extent; but as the light of science had not yet dawned on the masses of mankind, a knowledge of our art was almost totally lost in the gloom of the “dark ages.”

But at the revival of letters, dental science again made its appearance, in connection with medicine, and was mainly if not totally cultivated in this connection till near the beginning of the present century. About this period several members of the medical profession, conscious of the negligence manifested toward this department of surgery, turned their attention to it with commendable zeal and earnestness. Their views and discoveries were widely disseminated, and, by the light thus afforded, the darkness was rendered so distinctly visible that its dissipation was felt to be a necessity. From this period dental surgery was cultivated, for a few years, partly as a separate branch and partly in connection with the general profession, and was thus supported and led by the parental hand till able to walk alone.

When all things are duly considered, we must regard the mere working of its way into a separate state of existence as the greatest achievement of the dental profession. In its earliest existence, our young profession had much to contend with and many obstacles to overcome.



The prejudice and suspicion incident to any innovation were not lacking in this case; and these were, doubtless, in some measure excited and rendered more virulent by the character and conduct of members. Though for a time pretension without merit may be apparently successful, yet in the end it must fail. And accordingly many of those who attached themselves to the young profession from selfish and mercenary motives were soon estimated according to their true character, and were driven out by the force of public opinion. The proper formation and direction of this public opinion was no insignificant part of the work devolving on the worthy and legitimate members of our profession in an early day. Indeed, this part of the work is but very partially accomplished yet; and it will not be complete till the public mind is so enlightened as to render the tricks and impositions of the charlatan an impossibility.

In emerging from the darkness of neglect, it was little wonder if dental science found itself beclouded by the gloom of ignorance. No one who looks back through the advancement of science in any other department, will be surprised at a want of knowledge exhibited by the early dental surgeons. Their profession was in its infancy, their duties undefined, and their means of progress few and untried; and besides, they were few in number, and lacked that confidence in each other which is only developed by acquaintance and association. But, like children worthy of their parentage, they ransacked the fields of science, and brought their varied treasures into the storehouse of their profession. Anatomy, physiology, pathology, chemistry, and natural philosophy were all made to contribute; and guided by the light of these, our profession has progressed from the smallest beginnings to its present position.

As the dental profession came into existence, it felt the



want of a literature of its own. The great diffusedness of dental knowledge through the text-books of medicine rendered its acquisition tedious and difficult. Hence we soon find a number of treatises and essays devoted solely to dental surgery answering more or less perfectly the purposes of text-books. The permanent literature of the profession was rapidly extended, and in due time large volumes devoted to our department of surgery were published and widely disseminated among the profession.

But the publication of standard works could not keep pace with the rapid progress of dental knowledge, and the periodical press was resorted to. The progress in this department was rapid. The *American Journal*, the pioneer, was soon followed by others; and to this day there is perhaps no greater evidence of the vitality of the dental profession than its periodical literature.

But the light which began to be thus diffused only rendered the darkness more annoying—the taste for knowledge thus enjoyed only increased the thirst for more; and we soon find the more advanced and energetic members of the profession forming themselves into an association for mutual improvement in professional knowledge. Kindred associations were soon formed in other localities, till, finally, like our parent, we have local, state, and national associations, all doing much for the cause of progress.

A lack of thorough training in the various sciences pertaining to the profession was soon felt to be the great want. And as the uniform practice of enlightened communities bore testimony in favor of collegiate instruction, dental colleges became a professional necessity. These were organized, and we thus find our young profession in the enjoyment of all the means of improvement which are possessed by its parent, the medical profession.

The combined influences of these various agencies produced corresponding results. Each department of our



profession accordingly made rapid progress. The pathology of the principal diseases of the teeth and adjacent parts is much better understood than formerly, and of course the treatment is more correct and reliable. And in the mechanical department of the profession the progress is equally striking, both in utility and appearance. The unsightly ivory and the dead teeth are banished; and their places are filled by gems of the purest porcelain, surpassed only by the natural organs.

We have thus noticed briefly that part of the work already done. Need we tell you what our profession is now doing? Need we tell *you* that it is delivering old age from one of its greatest infirmities, and thus smoothing the passage of life's decline? that it is reproducing the faded charms of youth and beauty? that it is restoring to the unfortunate orator the musical intonations of his lost eloquence? that it is relieving humanity of one of its sharpest pangs? These are among the tamest of its triumphs. Diving deeper than all these, it is arresting the ravages of dental diseases, preventing their sad consequences, obviating the dire results of impaired and defective nutrition, thus lengthening out the span of man's pilgrimage, while adding much to his comfort and enjoyment by the way.

But it is useless to talk of the present. It is but the connecting link of the past and future—but the dividing point between two eternities.

Let us, then, for a moment, turn our attention to the future, and survey that part of the work yet to be accomplished. And here we would fain have the lengthened range of vision granted to the prophet on the mount; for we fear that much of our professional land of promise lies afar off—so far, indeed, that our carcasses will fall in the wilderness of effort that intervenes; yet, when we fall, we trust that you who are younger, and others who are



to follow in your footsteps, will press on toward the prize; "for there is yet much land to be possessed."

In a careful review and accurate estimate of the work that lies before us, there may be found much to discourage; yet it is better to take this view, and make this estimate at the outset, that the faint-hearted may be allowed, as in the army of Gideon, to turn back from the contest. Let us endeavor, then, to take a calm and deliberate look at the work before us.

Connected with that beautiful set of organs especially committed to our professional care, we find many evidences of the frailty of man. A want of harmony in the human constitution is usually developed by the earliest manifestations of the dental organs. The constitutional disturbances arising from dentition are many and aggravated. Some authors estimate that one-tenth, or even a sixth of the human race, die during this period; and all agree that the process of dentition has much to do in producing the morbid conditions so fatal in their effects. That this state of affairs results from the violation of the laws of health, none will deny. A portion of the work, then, that devolves on us is to ascertain these laws, and disseminate a knowledge of them, that consequences so serious may be avoided. When the cause is removed, the effect ceases. We must, then, in concert with the medical profession, search out the causes of difficult dentition, whether hereditary or incidental, and devise means for their removal, that the whole process may take place in accordance with physiological laws, and, consequently, without disturbance to the health.

But dental difficulties do not cease with the eruption of the organs. In many instances, the teeth decay as soon as they emerge through the gum; and but few persons arrive at maturity without losing some of those organs, and suffering the tortures of toothache besides. You



who are familiar with the admirable laws which the Creator has established for the formation and growth of the teeth, will agree that this is all wrong; and even the most casual observer, when he considers the bony hardness, and looks at the glassy enamel of the teeth, must conclude that they were made to last through life; when he sees them so beautifully adapted to the purposes of mastication, he must conclude that they were formed for *use* so long as a necessity for food should exist. This early decay exhibits a serious violation of the laws of health. It evidences that the teeth are imperfectly formed and developed, that the fluids naturally in contact with them are depraved, or that substances highly improper are permitted to come in contact with them. One of these propositions must be true, they all may be true. We are, then, called on to ascertain the precise nature and extent of the various influences brought to bear in the destruction of the dental organs. And if we find that hereditary predisposition exerts a malign influence, as doubtless we will, the public mind must be enlightened, and the habits of society reformed, till these organs no longer remind us that the iniquities of the fathers are visited upon the children. We must be able, from an examination of the constitution and habits of the patient, the state of the secretions, and the character of the decay in the tooth, to recognize the chemical qualities of the corroding agent in each and every case of dental caries. And, having ascertained these, we must know how to obviate its devastations and eradicate it from the system. This will require greatly increased knowledge in all the sciences pertaining to our profession—vastly increased light in all its departments; and when the triumph of dental science is complete, the arts of dentistry, operative and mechanical—both so important now—will almost cease to be needed.

Thus far, we have alluded only to our work as members



of the dental profession; but our labor does not cease here, and must not be so restricted. While we are members of the profession, we are also members of society at large; and as membership always implies corresponding duties, we are required, not as a profession, but as individuals, to bear our part in the cares and toils of life. And, as we are proud to call ours a liberal profession, it becomes us, for our own credit, to devise liberal things. Society always expects more from the enlightened and the educated than from those whose opportunities and attainments are more limited; and this is right. "To whom men have committed much, of him will they ask the more," is the language of the Saviour, while he applies the principle to his own government in adjusting the final affairs of men. We have, then, to do our part not only socially and morally, but we must contribute our portion to the general advancement of all useful knowledge.

But there is a limit to human knowledge. The finite mind can never approach, far less vie, with the Infinite. The science of our profession must, therefore, like other sciences, be but partially understood. In all cases of scientific search, whether we dig in the mines of knowledge or climb the hill of science,

Each deep explored reveals a deeper depth—  
Each height attained displays a height beyond.

Antecedent to each effect is its cause, and behind this is that which caused it; and thus we are led back to the philosopher's First Cause, which is none other than the Christian's God. This is the end of all science; and unless we are led in this direction we have studied to little purpose.

But, gentlemen, it is folly for us to further prolong this scene. The time has come for us to part. To part!—but shall we meet again? And if so, where? and when?



Shall it be in these halls a year hence, when your junior classmates are placed in the position now occupied by you? Shall it be in the dental society, or the national convention? Not likely in any of these. Ere another annual meeting it is not improbable that some of us will go the way whence we will not return; but if not, there is little probability that circumstances will be such as will enable us all to take part in any single assembly of our profession. There is, therefore, little probability of us all meeting here; but a convention is appointed; the time will be duly announced; we will all be called to attend; and, without any regard to circumstances, we will all be there. We have met here, and we part now. We will meet there; shall we part then?

But we must not detain. As members now of the dental profession, we welcome you to our ranks; as pupils of this Institution, we bid you farewell!



## RANDOM THOUGHTS.

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THIS paper is what its name imports. The thoughts here recorded are set down without any regard to order. Many of them were noted in memorandum, on waste paper, by the wayside, or at public meetings when the proceedings proved uninteresting. Some were suggested by the casual remark of a professional brother, some by a glance at a sentence in an article which time did not permit us to read; and some were not suggested at all, but sprung into existence of their own accord. We write them down to be relieved of them, just as a young lady marries an importunate lover "to get quit of him."

**Professional Hobbies.**—This term is generally used in an opprobrious sense—but why? Does the traveler treat with contempt and speak disparagingly of the faithful courser that has carried him safely to the end of a successful journey? And especially if he is traveling for a prize, and his steed has carried him far in advance of all competitors, is he not tender in his caresses and faithful in his attentions to the noble animal? And if the prize can only be gained by making the journey, and the way is so long and so difficult that but few animals can endure the travel, would we not regard as an ungrateful wretch the successful rider, should he malign or maltreat the faithful companion that carried him to the goal? And what if those who are distanced in the race disparage the qualities of his steed? Will he therefore discard him and



go afoot, ride a donkey or a spavined hack, or abandon the race entirely?

Well, to bring this thought home, the whole dental profession is, or should be, on a journey. The way is long and difficult. It is rough, uneven, and steep. It leads from the depths of professional ignorance and degradation to the heights of professional knowledge and respect. A prize is held out to all who make the journey and reach the goal—a prize made up of a series of prizes—which consists of all those blessings and enjoyments which make the life of the true professional man desirable over that of the charlatan and the impostor.

In a race or a journey, those who ride usually advance faster than those who walk. And if the pathway be unexplored, those in the rear are dependent on those in advance for a knowledge of the way and for the information which is necessary to overcome its difficulties. So in our profession—those who ride are in the advance, and those who walk follow behind, while those who stand still or sit idle are left out of sight, and cease to be regarded as members of the *body professional*.

But what do those in advance ride on? On HOBBIES—*professional hobbies*; for there are no railroads to knowledge in the dental profession. And why not ride hobbies, and rejoice in the qualities and capacities of our steeds? What is a hobby? Compare Webster's first and third definitions: "A strong, active horse;"—"That which a person pursues with zeal or delight." No mere pony or donkey, but a good strong courser which we may ride with "delight."

A professional hobby-rider, then, is one who selects some subject or professional principle as his favorite, examines it in all its bearings, pursues it in all its ramifications, and makes it throughout tributary to the wants of his profession. And his researches in this direction are a



success, like that of the traveler who, pressing in one direction, surveys a route or explores a river, while he who tries to travel two ways at once, fails to make progress in any direction.

All professional advancement has been and is made by hobby riding; but many fail to ride to the best advantage. Some mount a hobby, but finding it difficult to ride, dismount and take a fresh one. This is soon deserted, and another is taken up,—each one being left before it is broken into rank,—and of course but little progress is made. Others, again, mount their favorites, with whip and spur, and ride them to death without reaching their journey's end; and, being themselves too far exhausted to arrest a fresh steed, pine by the way, while others pass them and reach the goal.

Our advice is to select some favorite subject, pursue it with zeal, and push it with energy; but stop and rest before you are too much engrossed by it to think impartially on other subjects, and especially before the profession has become weary of hearing it. But don't cease to make progress. Lay hold of another, while this one rests, and follow it up with equal energy; and don't get discouraged if you are charged with riding hobbies.

**Platinum.**—We have no notion of writing a chemical dissertation on this “noble” metal. We only wish to retrieve its name from the gross profanations to which it is subject in our profession. A *noble* metal has the same right to its title that a *noble*-man has. A chubby little boy, as he trundles his hoop, may with propriety be called “Jim along Josey;” but when he goes with “a satchel to school,” he reports his name as “James A. Joseph;” and in due time may be entitled the “Hon. J. Along Joseph, Esq.”

Well, this metal was at first called “platina,”—a dimin-



utive of *plata*, silver. Being found in minute quantities, and having the color of silver, it was given a name which implied "little silver."

When it became better known, it was named in accordance with the approved system of nomenclature, and called PLATINUM. Let us drop the nickname, adopt the true one, and write it platinum. But if we must retain the old orthography, let us not pronounce it *pla-teen-a*, but *plat-i-na*—accenting the first syllable.

This is a small matter; but the credit of the profession is somewhat at stake. At the late convention, almost every member who had occasion to speak of the metal, used the obsolete, barbarous pronunciation, giving to strangers the impression that we were lacking both in taste and science.

**Ulceration.**—This term is very vaguely used by a majority of our profession. If alveolar abscess is referred to, it is often said that ulceration has taken place. In a large majority of the cases in which the term is used, *suppuration* and not ulceration is meant. If we pervert the word thus, we must needs coin a new one to express the true meaning of ulceration. Many cases reported in the journals as well as in verbal discussions, are unintelligible on account of the vagueness with which this and similar words are used.



## PROFESSIONAL LONGINGS.

---

DURING the Irish famine, Henry Russell was singing,

“There’s a good time coming;”

and he was a true philosopher who responded from the crowd, “Could ye fix the date, Mr. Russell?” Aye, the date! That is it that troubles us all.

“Hope, like the glimmering taper’s light,  
Illumes and cheers the way;  
And still, as darker grows the night,  
Emits a brighter ray.”

But, if we only knew *when* that light is to brighten and dazzle till the darkness flies away—if we only knew just the time that hope is to become fruition, how much of our care and anxiety for the future would be dispelled!

But if this train of thought is to be followed out, the heading of this article is a misnomer; and *human* longings is its appropriate title. But this would be a range too wide for my pen, and too general for a journal devoted to a specialty. So, let the hopes, the cares, the cravings, and desires of our special profession claim our present attention.

“There is a natural body, and there is a spiritual body,” we are told by the learned Apostle of the Gentiles. This statement is usually held as if it read, “There is a natu-



ral, and there *will be* a spiritual body." But, in the obvious meaning of the language, the spiritual body has its existence at the time of writing, as really, and in the same sense, as the natural body. The "body, soul, and spirit" are usually spoken of by inspiration as so many separate, special realities; and why the popular mind recognizes the separate identity of the body, while it denies such identity to the other two, is hard to understand.

Our Creator has given us two sources of information concerning Himself and His works. Leaving the critic to object to our terms, if he pleases, let us call one the Book of Nature, and the other the Book of Revelation. These two volumes do not, to our limited capacities, teach the same things; nor, where they do coincide, do they teach to the same extent, or with equal clearness. But that they never disagree is plain, in that both are emanations from Him who is "the same yesterday, to-day, and forever."

Then does the *first volume* teach anything about the *existence*, nature, capacities, or powers of the spiritual body? Let us read. What presumption! Let a blind idiot translate the Egyptian hieroglyphics; but let not man, in this benighted state, attempt more than a few letters of the alphabet of this wonderful book!

And let us learn the first letter from a fellow-creature, innocent, humble, and happy. If a crab loses one of its members, it is well known that a new one grows in its place. It grows the right size, and of a proper shape. The nutritive powers of the animal are not allowed to act at random. They are controlled by an agency unseen by material eyes. Something tells them where to lay each particle of matter, and when they have brought material enough. Some principle, or *thing*, acts as the Creator's vicegerent, and nothing is bungled. The animal grew to its normal shape and size, in the first place, under the



control of this agency, and now it controls the repairs. Is here a hint of a spiritual influence? "There is a spiritual body."

A hint, not less plain, is given by the reparative process in higher orders of animals. Wounds of the soft parts in man are healed, form and function being mainly restored; and even bony tissues are reproduced, so as to demonstrate that some unseen power is trying to retain to man his normal shape and condition. And who does not know, that when a part of a member is severed from the body, that member remains unconscious of its loss, and that the news of its severance is conveyed to the soul, or to the individual's consciousness, not by itself, but by other organs? When the roll of the company is called, after a battle, every man that answers to his name is regarded and reported as alive and present. When the soul (or the brain, may be), as captain of the organization, calls the roll of the bodily members, the dissevered member answers as it always did. The man who has lost an arm feels as if his arm and hand were still present. Irritation of a nerve fibre is felt, not at the end of the stump, but at the ends of the fingers which have been removed. That is, the feeling is just the same as if the fingers were present. They promptly answer "*Here!*" to the roll-call, and who, in our present state of knowledge, has a right to report them absent? Are there spiritual fingers to the spiritual body? "There is a spiritual body."

What is true of the fingers is true of all the organs. It is on this principle that "tooth-edgedness" and toothache are felt in artificial teeth—are felt by those who have no teeth. The organs which, it is claimed, have been removed, or their spiritual prototypes, are simply answering to roll-call.

Do these hints indicate that the "natural body" (that body formed by an aggregation of the physical organs) is



simply the servant, or the instrument, of the spiritual body? Does it not appear that the spiritual body fashions, moulds, or shapes the physical organs, the "natural body," to suit its own ends? That the physical or natural body is not essential to, and, indeed, has nothing to do with, personal identity, is evidenced from a single consideration. Those of us who have reached middle age do not possess the smallest particle of the physical bodies of our childhood; yet it is evident to our consciousness that we are the same persons. Matter which then constituted parts of our natural bodies, for aught we know, now aids in forming the bodies of beasts, birds, or reptiles; but in this whole process of waste and repair there is not the least confusion of identity, for the soul and the spiritual body are not modified by such things, but remain the same.

That the spiritual body is not obvious to our senses, is no objection to the theory of its existence; for spirits are all around us, ministering to our spiritual wants, or tempting us, through the instrumentality of our passions and propensities, to deeds of crime. Even the aged spirit who claimed that he was "going to and fro in the earth, and walking up and down in it," and who is described by a higher authority as one who "goeth about like a roaring lion," is not recognized by our ordinary consciousness. For a spirit or a spiritual body to be invisible, it needs simply to be transparent. But who, oh! who will satisfy our longing desires, by telling us what a spirit is, and how it acts on, and what its relation to matter is, and how it communicates with a kindred spirit?

When these questions are answered, and these longings satisfied, then we will know something of physiology. But here we know only in part; but there is a place, and there will be a time, where and when we will know even as we are known.



“One of the joys of our heaven will be,” I doubt not, a fuller and clearer knowledge of the refining and ennobling sciences than it is possible for us to obtain here. The existence of these longings is an evidence that they are to be gratified; and the limited attainments we are able to make now are an earnest of that which is in store for a higher and better state of existence.

Turn which way we will, in pursuit of professional knowledge, our view is obstructed by the mists and fogs of doubt and uncertainty. Take, for example, the disease we encounter most frequently. It goes on in its work of destruction, torturing childhood, turning the smile of the blushing maiden to a ghostly grin, bringing on premature old age, and shortening human life; and yet we know almost nothing of its nature, essence, or causes, and confess to this ignorance by continuing to give it a name which we know is a misnomer.

When a dentist looks at a decayed tooth he ought to be able, from its appearance, and from accompanying circumstances, to tell exactly what chemical agent induces the decay. He should know, also, the composition, the source or origin, and the *modus operandi* of the agent, as well as its antidote, and the proper mode of preventing its formation. But who is to tell us these things, and when will he tell us? And why must little, unweaned babes suffer the untold tortures of toothache? And why need they suffer the ordinary agonies of first dentition? Must the nutritive functions always be so perverted that this process, which ought to be a blessing as painless as sleep, shall prove a prolific source of misery and death? Who will teach us the laws of life and health, so clearly and thoroughly as to enable us to rear children who, with painless dentition, shall develop dental organs that will last to old age?



“Prophets and kings desired it long,  
But died without the sight.”

And so, I fear, many, very many, of us who have desired and longed to see these blessings rest on our race, will die with our longing souls unsatisfied. But what of it? Abraham *rejoiced* to see the day of Christ; “and he saw it and was glad.” The best view of the promised land ever obtained by the eye of an Israelite was that of Moses from the top of Nebo. So now, those in the profession whose faith and hope are normally developed and properly cultivated, have a Pisgah vision of the “good time” that is to bless mankind, through the instrumentality of our profession; and we see it and are glad.

What a wide field is still open for professional exploration, and how much wider the space covered by our ignorance than by our knowledge! Yet how often do we find men in our profession who think, no doubt, we are the people, and wisdom will die with us! As conductor of a professional periodical, I have often requested brethren to write something for publication; and the almost invariable answer has been, “Oh, there’s nothing left to write about.” I have suggested to individuals to take some subject and give it a special investigation, and then give us the results of their examinations; and the answers received have been, in substance, that there is no subject but has been examined and written to death. Now, if any suggestion here should prove useful in exciting to study, in stimulating our profession to explore untrodden ways, I will be amply rewarded for my trouble in writing this.



## FISTULOUS OPENING THROUGH THE CHEEK.

---

MR. N., aged twenty-five, called to have a tooth extracted on account of periostitis and incipient abscess. The tooth, a second lower molar, was easily removed, and but little hemorrhage followed its extraction. The tumefaction, however, continued and increased. A lead cap was fitted over the tumor, and pressure kept up by means of lint and collodion strips. The swelling disappeared and the cap was removed.

A month after the tooth was extracted, a small white tumor appeared on the outside of the cheek, and in a few days discharged a thick, unhealthy pus. About six weeks later, my attention was again called to the case, when I was surprised to find that there was nothing like granulations in the socket. Water injected into it passed entirely through the cheek. Indeed, a fine probe was readily passed into the opening in the cheek and up through the socket.

Having satisfactory evidence that there was no venereal taint, I concluded to rely, at least for a time, on local treatment.

The fistula was washed out with tepid water once a day, and about twice a week tincture of iodine was freely applied to its entire surface. The treatment was continued for two weeks, when the appearances were so favorable that the case was left to nature—watching closely, however, for any unfavorable symptoms. In four weeks from the commencement of the treatment, all was well.



This patient had always a weak constitution—was a printer, and was well marked with that pallor peculiar to his craft.\* The powers of life being feeble, active and frequent local medication would have probably destroyed rather than built up the parts to which it was applied. This remark is made from the known fact that many are in the habit of making daily applications of even active escharotics in such cases.

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\* He has since died of consumption.



## NITROUS OXYD AS AN ANÆSTHETIC.

---

THE use of protoxyd of nitrogen, after a protracted dormant period, has recently appeared as an epidemic. That it was so suddenly abandoned, and ether and chloroform substituted for it, is not remarkable when all the circumstances are duly considered. The non-portability of the gas in sufficient quantities, the lack of apparatus fit to use for a purpose so serious, and the inconvenience in handling such apparatus as was afforded, were well calculated to turn the attention of the profession in other directions. The transitory effect of the protoxyd was also urged as an objection to it, and justly, too, as far as prolonged operations are concerned.

But the nausea, lassitude, and prostration accompanying or following the administration of other anæsthetics, and the fact that now and again the wail for the dead was commingled with the fumes of chloroform, have to some extent induced anæsthetists to return to their first love, and the protoxyd is rapidly regaining the place which it should have never lost. And in consistence with the history of the discovery of anæsthesia, in this reform, if reform it be, the dental profession is taking the lead. Not that dental surgeons are more progressive or aggressive than general surgeons, but rather that most of their operations, though severe, are brief, and that their patients come to them, while usually the general practitioner must go to his—and many of his operations are protracted and tedious, rendering ether or chloroform more satisfactory.



In the use of these, the recumbent posture is very desirable; but this is impracticable with most of the operations of dental surgery; hence it is but natural that dentists, above all others, should regard the protoxyd with favor.

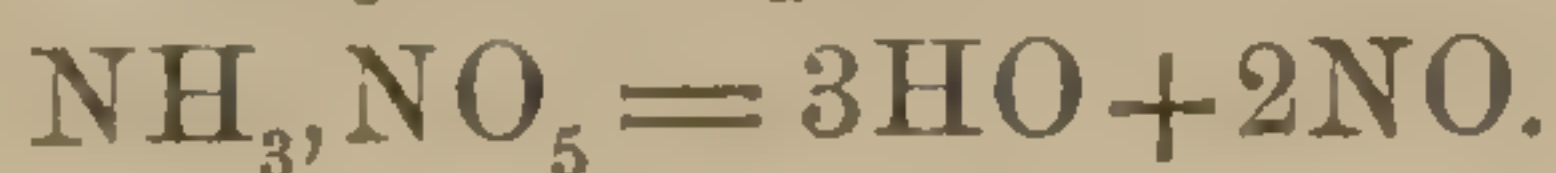
But it is possible that even a good thing may be carried too far. It is acknowledged by all that ether and chloroform must be pure. To obtain them thus, in the present state of pharmaceutical chemistry, is not very difficult. Reliable manufacturers of the articles are well known. But not so with the nitrous oxyd. While it is fully as important that it be pure, it is more likely to contain impurities than other anæsthetics; and instead of being obtainable from reliable pharmaceutists, the operator has to prepare it for himself. It is not, therefore, to be wondered at that mistakes occur and that mischief is done. Indeed, in the present state of affairs,—makers and venders of apparatus pressing their wares on the profession, members of the profession buying apparatus because their neighbors have them, and the people demanding freedom from pain in operations without a willingness to go out of their ordinary haunts to obtain it,—the wonder is that more serious consequences do not ensue. True, in the present lack of knowledge in regard to the proper and legitimate action of the protoxyd, the evils resulting from the inhalation of an impure gas are nearly always attributed to other causes. They are regarded as merely incidental, even though as legitimate as a burn on the finger from thrusting it into the fire. A *propter hoc* is regarded as a mere *post hoc*.

Protoxyd of nitrogen or nitrous oxyd is usually obtained by the decomposition of nitrate of ammonia. Several considerations in its preparation are worthy of close attention. The nitrate should be absolutely pure. It can now nearly always be thus obtained from reliable chemists. Its composition, as its name indicates, is one



equivalent of nitric acid united with one of ammonia. Nitric acid is composed of one equivalent of nitrogen combined with five of oxygen, and its symbol is  $\text{NO}_5$ . Ammonia is formed by the union of one equivalent of nitrogen and three of hydrogen, its formula being  $\text{NH}_3$ . The formula of nitrate of ammonia is, therefore,  $\text{NH}_3, \text{NO}_5$ . I am thus minute because I have no right to infer that the readers of the *Register* are all technical chemists. The water of crystallization is not included in the formula, as it has nothing to do with the phenomena of the decomposition.

Now, it will be observed that the three elements composing the nitrate are, when free, all gases. By their native elasticity they have a tendency to resume the gaseous form. This elasticity is increased by heat; and that is the reason that heat alone is able to decompose the nitrate. As the decomposition takes place, new affinities assert themselves. That between oxygen and hydrogen is perhaps the strongest known to chemistry. Accordingly the three equivalents of hydrogen take three of oxygen, and form three equivalents of water. The remaining two equivalents of oxygen take, each, one of the nitrogen, and form the nitrous oxyd, or protoxyd of nitrogen under consideration. The reactions which take place, when this order of decomposition is perfectly carried out, are clearly set forth by an equation:



When the nitrate is pure and properly decomposed, the only results are three equivalents of water and two of nitrous oxyd. But the nitrate is sometimes contaminated with *sal ammoniac*, in which case chlorine, a poisonous, suffocating gas, will be commingled with the nitrous oxyd.

But even if the nitrate of ammonia be pure, it may be decomposed by heat so as to give an impure nitrous oxyd,



or even none at all. Nitrogen and oxygen combine in so many proportions, and thus give rise to compounds differing so greatly in their chemical and therapeutic properties, that, to be safe, every step of the process of decomposition must not only be understood but accurately performed. For example, if the nitrate be decomposed at too high a temperature, instead of nitrous oxyd and water, as in the preceding equation, we may have binoxyd of nitrogen, called *nitric oxyd*, water, and free hydrogen, represented thus :



Or, at a still higher degree, we may have nitrous acid, ammonia, and oxygen, thus :



Or, a little higher, the changes are thus represented :



Any one who can read a chemical formula will see at a glance that in any of these decompositions, except the second, there is nothing that can sustain respiration for a single inhalation, while an active corrosive poison is present in each of them.

But it is claimed by some, perhaps by many, that these and all other impurities are removed by washing, that is, by passing the gas through water on its way from the generator to the receiver. At first sight this is plausible, and may therefore deceive many. But let us examine, as the health and perhaps the lives of our patients are at issue.

Nitrous acid,  $\text{NO}_4$ , and ammonia,  $\text{NH}_3$ , are both highly soluble in water, and may therefore be readily removed by washing. But with the nitric oxyd, or binoxyd of nitrogen,  $\text{NO}_2$ , the case is far different. And, as it is the poison most likely to be formed, it is very important that it be understood.

Nitric oxyd is a colorless, tasteless gas, about as heavy



as atmospheric air; it excites violent spasm of the glottis when an attempt is made to inhale it. Water dissolves only *about 11 per cent. of it*. In contact with atmospheric air, it is converted into *nitrous acid*, which, in contact with water (liquid or vapor), is changed to *nitric acid*. (See Turner's, Graham's, or any standard work on chemistry.)

From the above, it will be seen that nitric oxyd cannot be washed out of nitrous oxyd, as water dissolves only 11 per cent. of it, while it dissolves about its own bulk of nitrous oxyd. If generated by itself, or along with nitrous oxyd, it will pass through the washers into the reservoir or gasometer. Then, if it be inhaled, its effects may be varied. When pure, it cannot be respired on account of the violent spasm of the glottis produced by it; but diluted with other gases, it may be. Let it be remembered that it is highly corrosive, and its effect on the mucous membrane of the air-passages may be appreciated.

But this is not all, nor the half: nitric oxyd in contact with air turns to nitrous acid, and this, in contact with water, to nitric acid. As both air and water are always present in the bronchial tubes and cells of the lungs, it is not possible that nitric acid be not formed if nitric oxyd be inhaled; for the laws of chemical combination are laws of the unchangeable God.

Nor is this all. But if one would boil nitric acid, and cause a patient to inhale the vapor, it would be regarded as quite enough to damn him to infamy, and drive him from the profession. But in that case the acid would be in its ordinary or quiescent state, while in the other its nascent condition gives it greatly increased energy of action.

From the above it follows that nitric acid is *the impurity* to be dreaded in the use of nitrous oxyd as an



anæsthetic. The question arises, how is its presence to be avoided? Various attempts have been made to answer this. Protosulphate of iron is sometimes put into the wash-bottles. This salt absorbs nitric oxyd. But unless we know how much we are going to make, while not intending to make any, we cannot tell how much of the sulphate to use. Another method is, to admit atmospheric air into the gasometer, the oxygen of which changes the nitric oxyd to nitrous acid, which will be removed by the water; but there is no way to determine how much air to admit. If too much, it dilutes the nitrous oxyd. If too little, it fails to remove the nitric oxyd. In short, the only way is not to generate any nitric oxyd. And, to attain to this result, we must have apparatus by which the heat can be kept nearly uniform through the entire process of decomposition. Take, for example, a gasometer which requires an hour and a half to fill it. The process may go on exactly right for an hour and a quarter, but, by too high a temperature during the last fifteen minutes, enough of nitric oxyd may be formed to poison the entire contents of the gasometer. No man can give such attention to the process, with ordinary apparatus, as will enable him to *know* that he has not a mixture of nitrous and nitric oxyds in his gasometer, instead of *pure nitrous oxyd*.

With the uncertainty of the ordinary processes of decomposing nitrate of ammonia it is not strange that soreness and congestion of the air-passages are so frequently observed after the use of the nitrous oxyd. Defective apparatus in the hands of the inexperienced, and those without chemical education, is likely to result imperfectly. A man may be a good anatomist, and a fine operator, without a thorough knowledge of this process; for it is *strictly chemical*. Many are honestly experimenting without sufficient chemical knowledge to be aware of the danger—some, possibly, so far back as to be unwilling to learn.



Though a teacher of chemistry for nearly a quarter of a century, I never would, *never did*, and NEVER WILL use a nitrous oxyd apparatus, even for amusement, without the ability absolutely to control the temperature at which the gas is generated. The man of science has no more right to profane the laws of nature than the minister of the gospel has to profane the laws of revelation.



## “TEETH EXTRACTED WITHOUT PAIN.”

---

IN the dental profession, as in the world, there are two kinds of people. In regard to the pain inflicted by cutting out sensitive dentine, extirpating the pulp, or driving a wedge between the necks of the teeth, I have heard heroic operators complacently remark, “The pain’s the patient’s business. Mine is to make a good operation.” And this is true, but not to the unfeeling extent to which it is carried by those with whom it is a favorite expression. The other class, through a too ardent desire to avoid the infliction of pain, often disregard the patient’s best interests; and of the two errors, this is by far the more serious.

In the present condition of the race the amount of suffering directly resulting from morbid dentition, and diseased dental organs, is so great, and its character so severe, that simply to think of it is appalling. The rueful countenance, the piteous wail, the convulsive shudder, the stupor, and the death of the little babe, are sad comments on the condition of fallen man. “Who did sin—this man or his parents, that he was born blind?” is a melancholy query propounded to him who spake as never man spake. The light of science corroborates the teaching of inspiration, that the iniquities of the fathers are visited upon the children.

It is then to be expected that, for several generations yet to come, defective teeth will be found, and some so



defective that their restoration to health will not be practicable. And as teeth diseased beyond a slight morbidity are absolutely intolerable, at least occasional extraction will be indicated, and will even be necessary, and if necessary, pain or no pain—“that’s the question.”

At present the extraction of teeth is more frequently required than are all other surgical operations combined. And, however lightly some may regard it, the extraction of a tooth is a severe operation. It is painful, and produces a decided nervous shock. The teeth are, mechanically considered, very firmly attached to the organism. Their vital connection is also very decided. I have known men who neither moaned nor murmured at being mangled by bullets, who, nevertheless, shrieked and trembled from the pain of ordinary tooth-extraction. In most cases the extraction of a dozen teeth is as severe as the amputation of an arm, and the consequences are less serious only on account of the difference in the structure and vitality of the parts mutilated. The surgeon who would, under ordinary circumstances, amputate an arm without resorting to anæsthesia, would be guilty of malpractice. Is the dental surgeon, then, to be criticised and condemned for a similar resort in an operation equally severe? Or, because his operation is divisible, must he reduce the vitality of his patient by a series of a dozen painful operations, with as many nervous shocks, to say nothing of the mental anguish, protracted through the several intervals?

But the quotation with which this is headed is regarded by some as a baneful announcement to afflicted humanity. Even with pain, far too many teeth are extracted, say they; and no honest, well-informed man will dispute this. But if this is meant as an argument against painless extraction, it proves too much. The improved forceps must be thrown aside, and the barbarous turnkey resumed. Men of science and skill must cease to operate, and leave ex-



traction to the blacksmith and the butcher. By a good deal of management the operation might be made far more terrible than ever, and even then, it is probable teeth would be extracted that ought to be saved. If sound here, the argument is equally valid in general surgery. Anæsthesia must be abandoned, for too much cutting is done. Patients insist on having organs removed that might be saved. It will not be safe or proper to mitigate the pains of maternity, for even as matters stand now, too many babes are born in some families.

As an admirer of human organism in all its integrity, I yield to no one. I never remove an organ or mutilate the system in any way without a feeling of sadness. If any one is more conscious than I that thousands of teeth are daily sacrificed on the altars of avarice and ignorance, I will sit at his feet and listen to his recitals as a child listens to the tale of midnight murder. But as long as any mutilation is necessary, let that be painless whenever practicable. I know it is urged by some that pain is a blessing. Certainly not a blessing *per se*—in its own essence. Though ignorant of what freedom from pain is, my faith takes hold of the promise, “There remaineth a *rest* to the people of God,” not a *pain*; that is not reserved for them, as it would be if a blessing.

The removal of Adam’s rib took place while he was in an anæsthetic state, and it is a wonder that surgery has been so slow to take the hint legitimately deducible from this fact. It is to be hoped that the day is not far distant when all surgical operations will be painless.



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